The Journal of

THE AUSTRALIAN INSTITUTE OF AGRICULTURAL SCIENCE

Registered at the G.P.O., Sydney, for transmission by post as a periodical.

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VOL. 4, No. 2 JUNE, 1938

The Profession of Agricultural Science

The ballot organised by the Federal Executive last March for the acceptance or rejection of the final draft of the Memorandum and Articles of Association has resulted in an absolute majority verdict from members in favour of the amended Constitution. The outcome of the extensive and painstaking negotiations directed at formulating a sound, workable basis upon which the Institute might operate—negotiations which have been in progress actually for some five years—is therefore a matter in which the active participants can feel a very real sense of satisfaction. The original and somewhat tentative draft was punctuated at not a few points in a way which was calculated by many to foreshadow trouble. Subsequent events quickly demonstrated the urgent need for modification of certain clauses if the Institute was to fulfil adequately and happily all those functions which most members envisaged at

the outset for their professional body. That need was no sooner sensed than exchanges of ideas passed from one Branch to another, until at the first general meeting of the Institute in Sydney last year progress toward a final settlement was reached when delegates from all States examined the entire document, clause by clause, and effected the alterations now embodied in the printed Constitution. The delay in placing the final draft before members for their acceptance was not to be avoided in view of the close attention which had to be given to the Articles by legal authorities, but in our fourth year of operation it is indeed gratifying to have reached the stage where all hurdles have been successfully and happily negotiated, so that with complete finalisation of all matters constitutional we can now proceed with incorporation. The Institute has thus passed another important stage in its history. On 31st May, the President, Professor S. M. Wadham, presided at what was the final meeting of the Executive Committee. Under the new régime that body ceases to function, for, as provided in Articles 31 and 32, the Institute is now to be managed and governed by a Council comprising the President, General Secretary, General Treasurer and one delegate from each Branch. The sterling work performed by the Executive Committee in its wise and careful guidance of affairs in the early and often anxious days of the Institute's formation is a matter for which members generally will feel a tremendous debt of gratitude. It would be far from unfitting to allude at this stage to the enthusiastic and tireless efforts of each Committeeman in person, but a special note of appreciation should be recorded of the admirable work performed by the Hon. General Secretary, Mr. A. J. Vasey, since the inception of the Institute.

In this new phase of our professional history, the incoming Council will be confronted with the task of guiding the destinies of the Institute, and of ministering to the needs of the profession. The task is one of no mean responsibility, and Branches will appreciate the need for ensuring that their representation on the Council is adequate from every point of view. To be appointed a Councillor is an honour, but the appointment also carries with it certain definite obligations, and the strength of the Council's lead in affairs generally will be very largely a reflex of the strength of the entire personnel on the governing body. Many and varied as are the matters to which the Council will wish to address itself in the first year, there is perhaps a prior claim to be made for consideration of questions affecting status and conditions of appointment of members within the profession. There is a growing feeling in certain quarters that even such a matter as remuneration in various avenues of employ must of necessity be a factor for early attention if the Institute is both to fulfil one of the functions implied in the Memorandum of Association, and to retain the active and financial support of its members. It will be argued by some persons that we must dissociate ourselves entirely from everything savouring of " trade unionism ". Be that as it may, but the fact remains that agricultural

science is a growing profession in which are engaged numerous workers who have linked themselves together as a corporate body not only to promote the advancement of agricultural science and to encourage the interchange of ideas between workers throughout the Commonwealth, but also for the safeguarding of the best interests of their profession. That is made perfectly plain in our Constitution. The tenets of other Australian professional organisations in this matter are too well known to require mention, and what these bodies have been able to effect both for members individually and their professions at large has had the effect of strengthening the organisations in a way which perhaps nothing else would have done. Those who continue to spurn consideration of such questions as " status ", " conditions of employment " and " remuneration " can probably well afford to take that attitude. Nevertheless, the vast majority of agricultural scientific workers in the Commonwealth will welcome early attention on the part of the Council to these aspects which are so definitely implied as " objects " in the Institute's Constitution. It may fairly be predicted that with improvements in status and conditions of employ, the natural outcome would be to cherish more jealously high ideals of workmanship and service. That alone should provide a basis for immediate action.

Grass Drying

By

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During a tour of England and Scotland in the summer of 1937, the author saw a number of grass-drying plants in operation, and as the subject is of general interest to agriculturists the article which follows is designed to give a short account of the process and of the product.

It has been known for long that young grass has a high nutritive value, but the difficulty of working it has prevented its use for hay. Woodman[1] and others, working at Cambridge, demonstrated that young grass cut at short intervals keeps its high nutritive value throughout the year, and that this high value is independent of the botanical composition of the herbage. Young grass has a higher crude protein content, a more digestive cellulose, and higher mineral and carotene content than hay prepared in the ordinary way.

The invention of the cut-lift combine, which cuts and deposits the young grass in a trailer in one operation, has solved the problem of harvesting, and the rapid drying of the grass in artificial driers preserves all of its nutritive

qualities practically unimpaired. Dried grass, cut at the right stage and properly prepared so that only from 2 to 10 per cent. of moisture is left in the final product, may contain up to 28 per cent. crude protein[2] but poor samples may contain as low as 9 per cent. The high protein content and the high digestibility of the cellulose along with the health-giving properties of the minerals and carotene make the product an excellent concentrate, and the idea of growing and preparing concentrates on the farm as a move towards self-sufficiency appeals strongly to the English farmer who can afford the money for the plant. The plant necessary for grass drying is, however, expensive, the bigger complete units costing more than £2,000, so that it is out of reach of all but the bigger farmers and companies.

The process is simple. Grass is cut every three to six weeks in the young leafy stage before the flowering shoots appear. It is transported immediately from the field to the drier in which it is exposed to very high temperatures so that moisture is given off rapidly. The grass loses its moisture in from 15 to 45 minutes, and is then baled or powdered. It must not be stored loose or it will lose colour and carotene content.

Types of Driers.

Driers are of many types, among which the following may be noted :

1. Tray driers in which the grass is hand shaken from one tray to another in the process of drying.
2. Endless belt driers in which the grass passes steadily through the heated container on a belt, and comes out dry at the other end.
3. Revolving drum driers.
4. Pneumatic driers in which the grass passes through intensely hot air in tubes.
5. Dual process driers in which the grass is first soaked in hot water, then pressed in rollers to obtain a liquid extract (dried subsequently to obtain the minerals and carotene) and finally dried on a series of conveyers in hot air.

In the pneumatic type, the temperature to which the grass is subjected on entering the drier may be over 800° C., but in most types the temperature at the inlet is 200° to 400° C. The evaporation of moisture prevents the moist material from scorching, and the time of exposure to heat is so regulated that the dry material passes out of the machine before there is danger of scorching.

The cost of the operation depends on the amount of water to be evaporated. Young grass contains about 80 per cent. moisture, but may contain more. Dew or rain on the grass increases the amount of moisture to be evaporated and consequently the cost of drying. Careful costing during 1936[3] in England showed that the cost of producing a ton of baled dried grass was £5 18s. 6d. This took all items into consideration—rent of land, producing grass, cutting,

drying, and baling. In England up to the present there has been a ready sale for all dried grass produced, at a figure (about £10 per ton) which showed a good profit, but there are a number of agriculturists who claim that a concentrate of equal nutritive value for milk production could be purchased for less. The value of the protein for milk production falls off somewhat in the autumn grass as compared with the spring grass.[4]

The green colour, sweet smell, and high nutritive and health values of dried grass have caught the popular imagination in Britain, where the long winter months make stall feeding of stock essential, so that the number of driers is steadily increasing and production has not yet reached its peak.

Lucerne cut for hay at flowering compares with only the medium grades of dried grass in nutritive value. Lucerne cut at the pre-bud stage and dried, however, contains all of the good qualities of dried grass and has, on the average, a higher crude protein content. Dried young lucerne is being used in increasing quantities in Europe and America, and, where freight is an important consideration, might be able to compete against lucerne hay even in Australia.

Possibilities in Australia.

In Australia, periodically recurring droughts in certain areas arouse the need for relief foods, and dried grass which is easy to transport might reasonably be thought to be a possible solution. The dry hot climate, too, makes possible the drying of grass with less fuel than is required in England, especially if the grass is allowed to wilt before taking to the drier.

Grass partially dried in the sun loses carotene rapidly and the cost of collecting the grass is increased because the cut-lift combine cannot be used in such cases, so that little, if any, advantage would be gained by partial drying in the open. It might be possible to dry grass, in the hot dry irrigation areas for instance, by using fans to circulate atmospheric air in driers under cover with a minimum of artificial heat. This would be a slow process and the output from the machine might be too small to be economically successful.

Dried grass as a drought relief fodder would have to meet competition from maize, lucerne chaff, and concentrates already on the market in Australia, and it is doubtful if it could compete successfully with these in the open market if a maintenance ration only is desired. There may, however, be a niche in the dairy or poultry industries which can be filled better by this interesting product than by any other.

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Some Introductory Principles of Pasture Ecology

By

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Pasture may be defined as the herbage* which serves as the subsistence of the grazing animal. It assumes different aspects according to whether the animal is free, maintained under nomadism or restricted within permanent boundaries.

So long as man remained a hunter, or indulged in nomadic husbandry, the conservation of the plants which maintained his herbivora demanded little consideration. With the development of a settled existence, however, the value of pasture took on a new meaning and increasing care was devoted to its culture, particularly in temperate regions, where the husbandry of the pasture has gradually become as much a matter of importance as that of the livestock.

The trend of plant succession, under the influence of man and his animals, has varied greatly according to the climate. Denudation has frequently occurred in arid and semi-arid regions, with, in some cases, the conversion of extensive tracts into desert. On the other hand, the influence of timber removal and grazing control, under favourable climatic conditions, has tended to evolve permanent herbaceous swards of good value. In the absence of cultivation, fertilization and seeding, these swards have received the term " natural pasture ".

The utilization of natural pasture was supplemented from earliest times by the cultivation of crops for forage. More recently, the seeding of land for permanent pasture has been employed as a means of enhancing the derivation of livestock products from the soil. This practice has now become closely associated with the progress and stabilization of agriculture ; but its pursuance is beset by a complex of problems fundamentally dissimilar from those relating to the culture of individual crop plants.

The study of pastures as such is a comparatively recent development ; an appreciation of the many interesting factors involved has only become possible with the progress of modern ecological thought, which owes much to the work of Clements,[4] [5] Tansley,[27] Cockayne,[7] [8] Bews,[2] Weaver[34] and many others. To the concepts of ecotypical variation and ecotypical response, first enunciated by Turesson,[31] [32] and developed in particular by Stapledon,[21] material advances in pasture husbandry are specially due.

* The term " herbage ", as used in this sense, includes the leaves of edible shrubs and trees normally grazed, as well as the above-ground portions of edible herbs.

The keynote to a proper interpretation of the pasture complex, however, is its intimate and essential association with the grazing animal, which the work of Stapledon,[20] [21] [23] [24] [25] etc., has done most to reveal; and the origin of many recent investigations concerning pastures is to be found in the stimulus derived from this work.

Features of the Pasture Complex.

The special features of the pasture complex, as distinct from the single agricultural crop unit, may be enumerated briefly as follows:

1. The presence of the grazing factor is an essential part of the environment of all pa tures.
2. The pasture must be regarded, even in its simplest form, as an association.
3. The pasture association is usually a mixture of plant forms representing widely differing families. These forms may be conveniently classed as (*a*) ecospecies, (*b*) ecotypes.
4. Inter-specific and inter-varietal competition are features.
5. The association behaves usually, but not invariably, as a sere.
6. Variations in the environmental plexus exert differential effects on the individual plant forms and greatly influence the trend of competition. Even in the case of the biotic proclimax (disclimax[6]), more or less continuous change in botanical composition due to aspection and annuation is to be expected.
7. The final evaluation of the pasture must be in terms of capacity for nutrition and the synthesis of animal products.

The soundest approach to the pasture problem appears to be through the investigation of basic ecological factors in terms of their relationship to the behaviour of plant forms, first as individuals, then as aggregates, and finally as communities of associate forms.

The importance of each particular set of factors, whether climatic, edaphic or biotic, becomes greatest as it tends to become limiting or critical in its effects on the actual or potential association dominants. Thus, the limitations imposed by low winter temperatures have led to studies of frost resistance in North America and methods of improving winter production in Great Britain. As rainfall becomes limiting, studies of drought-resistance and water relationship assume significance.

In Great Britain, Stapledon (*loc. cit.*) has paid much attention to biotic factors, which have been shown under certain conditions to outweigh considerably climatic and soil influences; Stapledon advises as an introduction to the study of grassland Pickworth Farrow's work[11] on the influence of the biotic factor (rabbits) on the vegetation of Breckland. The effects of consolidation and treading[1] and of controlled grazing[12] have also proved highly significant in this connection.

More recently, soil conditions have been found to be critical in the establishment of improved pasture on the rough hill grazings of Wales and Scotland,[24]* whereas Watt,[33] commenting on Farrow's work (*loc. cit.*), states that the generalizations made, though valuable, were too sweeping, disregarding, as they did, soil types. Levy,[15] in New Zealand, has done a great deal to establish relationships between the pasture and the edaphic habitat, while Klapp[13] has correlated the distribution of herbage plants with soil reaction in Germany and has also devoted attention to numerous other soil and climatic factors.[14] The importance of taking into account extreme or intermittent conditions as distinct from average or normal conditions has been stressed by Taylor.[28]

Where the vegetation climax is present in its native condition, as in most new countries, it affords a valuable composite index of the climatic and edaphic environment, and therefore an indication of the agricultural crops or pasture types which may be grown. The value of the native vegetation in this respect has been made abundantly evident by the work of Shantz,[18] Clements (*loc. cit.*), Shantz and Piemeisel.[19] Prescott[17] found a close relationship between the major groups of Australian soil types and the corresponding vegetation associations, while Trumble[29] has related pasture development in South Australia to the main types of climax vegetation.

Important Considerations.

The practical utilization of the relationships established between herbage plants and environmental factors lies in the culture of those forms best adapted to the environment available and *en rapport* the maintenance or amelioration of the modifiable conditions so as to ensure satisfactory development of the selected forms. The final selection of the pasture association and the treatment adopted must take into account, of course, the full provision of those nutrients required for the types of animal production in view, but this has not so far proved a simple matter in practice ; and the measurement of animal production under field conditions can only be effected usually on a comparatively large scale. Crampton and Finlayson[9] recently employed rabbits as a measure of the nutritive value of pasture grass, and showed that *Phleum pratense* produced better results with rabbits than did *Phalaris arundinacea*, although the usual proximate and mineral analyses of the two grasses showed little difference. While the result is an important one, it is obvious that nutritive value can only be satisfactorily assessed in terms of normal pastoral products.

Although the fundamental importance of the ecological viewpoint in pasture investigation has now been established, much remains to be accomplished in regard to the numerical evaluation of environmental factors

* The work carried out by the Welsh Plant Breeding Station, Aberystwyth, on the improvement of hill grazings has been published as Bulletin H.14 of the Station (1936).

and their effective separation as contributing causes to the phenomena of seasonal growth and production by the pasture complex. This is particularly true in the case of climatic factors, the inter-relations of grass-legume combinations and the elucidation of both edaphic and biotic effects on botanical composition and productivity.

Geographically, pastures may be classified into five major groups, following largely Bews' treatment of the world's grasslands.[3] These are (1) tropical, (2) sub-tropical, (3) temperate, (4) Mediterranean, (5) arid. In this classification, which is particularly suitable for Australian conditions, a distinction is made between the temperate and the Mediterranean types of environment. It is necessary to consider each major climatic region separately, in terms of its own environmental relationships ; and it is only after similar studies have been carried out in different regions that it becomes possible to assess the rôle of individual factors common to each habitat.

Investigations in South Australia over the period 1925-37 have been carried out chiefly at the Waite Institute as a main centre, with, in addition, some twelve sub-centres representing widely differing habitats. As the work has progressed and a knowledge of the climatology, pedology and vegetation of this region has become available, it has been found possible to map the agricultural areas of the State in the form of edapho-climatic zones, each suitable for a particular form of agriculture and for the development of pastures of a particular type.[30]

The principal features employed have included the native climax vegetation, the mean length of the effective rainfall season, the amount of influential rainfall and the more important intra-zonal soil types. As a result, the representativeness of different experimental centres may readily be assessed, and data from a single centre or group of centres applied with reasonable certainty to definable areas of country.

The correlation of species or strain with habitat appears to be very largely a function of the limits imposed by unit factors or groups of factors. Thus in South Australia the growth and distribution of mid-season subterranean clover are limited by the length of the effective rainfall season.* The production and nitrogen accretion of the clover are also strictly limited by the available phosphate content of the soil. Recent investigation has indicated, moreover, that this clover is probably limited by an increased lime status of the soil. Within the 7·5 months isochrone for effective rainfall, the growth of subterranean clover on the slightly acid podsolised soils is both normal and vigorous, but it fails on coastal foraminiferous sands of an alkaline character and on heavy black soils associated with limestone. It is becoming apparent also, that in the

* Donald, C. M., and Smith, C. A. N., Jr. C.S.I.R. 10 : 277-290 (1937), have recently shown that the rate of evaporation during the flowering period is a specific determinant of seed production in subterranean clover.

mallee type of environment, which is climatically suitable for the development of early subterranean clover, the growth of the species tends to be limited by increasing alkalinity, with the occurrence of much calcium carbonate. This all serves to emphasize the importance of separate limiting factors in determining the growth and distribution of herbage plants ; and the adaptation of species and strains to particular environments may be expressed in terms of an absence of limitation on the part of individual habitat factors.

Under Australian conditions the biotic factor, while an essential part of the environmental complex in pasture experimentation, has not yet become the subject of much critical investigation. With the elucidation of the relationships between herbage species and their edapho-climatic environment, and the evolution of satisfactorily permanent and productive seeds mixtures, the influence of biotic factors becomes of increased importance and should repay detailed investigation.

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Agricultural Extension Work*

By

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(With a view to creating an atmosphere suitable for discussion of extension work, Mr. Gillespie prefaced his remarks with an illustrated description of the nature of agricultural practices in the several Australian States and New Zealand, and stressed those points which impressed him most during his ten years' experience of travelling throughout the Commonwealth.—Ed.)

In New Zealand, extension work has apparently developed strongly along the district officer plan. There are 43 full-time district instructors, 21 of whom possess university degrees—19 in agriculture and 2 in science. Twelve more hold diplomas from agricultural colleges such as Lincoln and Hawkesbury. An interesting development is the formation in various districts of pig councils, assisted by the Government. There is a degree man as superintendent of the Pig Council, as well as an extension officer. Another interesting branch of the Department is that devoted to wool-growing, classing, etc., the officer in charge being a master of agricultural science. This work is principally concerned with the preparation and classification of wool for marketing. The officers of the Department receive definite yearly increments, commencing at £255 and rising to £490.

The eight district advisers resident in the country districts of South Australia give active support to the Agricultural Bureau, which is functioning satisfactorily. Agricultural graduates commence at a salary of £367 and rise to £421, three years after joining the service. It is interesting to compare this with the salary of veterinary scholarship holders, who begin at £421 in a class which reaches £571.

In Western Australia, it is the policy to engage, for extension work, men as highly qualified as those engaged for research. There is a high commencing salary, namely £366, which is paid to graduates who commence their employment direct from the university. If, however, the graduate has obtained help under a cadet system, he receives a salary of £270 during a probationary year, and then rises to £366. Yearly increments are automatic at the rate of £12 a year for the first three years, when he is transferred to the next grade. The cadet system appears preferable to the Victorian system of free places, as an undergraduate receives a monetary allowance, and is expected to work at the Department of Agriculture when not required for lectures at the university.

In New South Wales, 87 officers are employed on extension work, the majority of the field staff being young men who have gained the diploma of the

* Presidential Address to the Melbourne University Agricultural Society on April 29, 1938.

Hawkesbury Agricultural College, and who have received further training of about six years' duration in the course of their work on the Department's experiment farms. There are only about eight agricultural graduates employed on extension work. The commencing salary of agricultural instructors is £304, rising by definite increments to £404. There is a block at this salary range, which is unsatisfactory from the instructors' point of view.

There are 21 Tasmanian district advisers employed full time on agricultural extension work, and agricultural surveys and farm management supervision are considered important features. Only graduates with experience have been engaged by the Department, although there is nothing to prevent the Department engaging a particularly brilliant graduate direct from the university at a salary of £351. Few increments were given during the depression, but during the last few years increases in salary have been given to a number of extension service officers.

Of the 266 technical officers in the Victorian Department, there is the equivalent of 103 on full time extension. Of these, 35 are graduates, either on full or part-time extension work. The Victorian Department has more agricultural graduates in senior positions than any of the other Departments. There is a lack of district officers whose headquarters are situated away from Melbourne, this lack being most obvious in the agricultural division. There is a high percentage of agricultural graduates in the service, most men being taken direct from the university. There is no officer detailed for advice in connection with the pig industry, and there is only one officer specifically connected with the sheep and wool industry. Altogether there are 56 agricultural graduates in the Department, and of these 20 are on a yearly contract. There are no set increments, and they usually remain on this contract until a vacancy occurs on the permanent staff. This leads to dissatisfaction.

The disparity between the salaries paid to agricultural graduates and veterinary graduates is evident in Victoria as in other States. This, in my opinion, is partly due to the law of supply and demand, and, while every effort must be made to increase the demand, it is also partly due to the strength of the Veterinary Association. Other professional associations have shown how the professional status can be raised by organisation and control.

The Queensland Department is in process of reorganisation, and no information could be obtained from that quarter.

Progressive Efforts in Tasmania.

Of the Government extension services mentioned, each probably has its good and its bad points, but I am most attracted to that of Tasmania, where there is a close watch kept on the economic result of the advice given by Department officers. This is done by means of economic surveys and a farm management supervision service. The field work in connection with the

Agricultural Bank enables the acid test of £ s. d. to be applied to the advice given. Farm management is a complex business, and when a farm is handicapped by a shortage of capital many practices which are profitable when demonstrated on experimental farms must be very considerably modified under local conditions.

In theory, it is sound for the Agricultural Department to have the supervision of expenditure of advances for agricultural purposes made by Government departments, and to have the complete revaluation of soldier settler properties, and in practice Tasmania is doing it. It is only ten years since the Tasmanian Department was drastically reorganised, and although these have not been easy years, trained observers speak of the good work being done today, and the progress being made in building up the efficiency of the primary producer.

I might suggest that extension work is required not only amongst the farmers, but also between the various State departments of agriculture. In one State, for example, you are told that the renovation of lucerne is not beneficial to the stand to any marked extent, while in a neighbouring State you will be told that renovation is strongly desirable. The liming of the land is advocated in one State, but not in the next.

One method of overcoming this difficulty would be to restrict the work of the State department of agriculture to that of an administrative and educational nature, and to develop the work of the Council for Scientific and Industrial Research to include not only national research into agricultural problems, but investigation into problems with a more or less localised application. We have an example somewhere approaching this state of affairs in South Australia, where the Waite Institute is carrying out research of special local interest, and is relieving the State Department of Agriculture of the necessity of carrying out much of the research work which at one time was done.

Extension Work by Non-Government Bodies.

Apart from the agricultural extension work done by governmental bodies, several private firms and organisations have realised the cash value of firstly building up goodwill amongst their customers, and secondly, safeguarding their investments. For example, several large fertiliser companies are employing men who have studied agrostology and who are available to give advice to farmers. These men have superimposed on their theoretical knowledge a large fund of information which they have obtained by discussing farmers' problems, and by seeing the results of various farmers' experiments. It would be quite fair to hold these men responsible for a considerable percentage of the increased acreage treated with fertiliser and sown with introduced pastures.

Then again, large organisations who lend money to primary producers are beginning to realise the value of science in protecting their outlay. One

large insurance company has improved properties which it has been compelled to take over owing to the indebtedness of the owner. These properties have been improved with the idea of increasing their value to that stage at which a price can be obtained which will cover the indebtedness. As has been already shown, the Rural Bank of Tasmania is recovering what appeared to be bad debts by using a trained officer to reconstruct the farm management of the occupier. There should be room for great development along this line. The trading banks, insurance companies and private firms could not only attempt to recover bad debts in this way, but could prevent bad debts to a large extent by having one or more agricultural scientists on the staff to scrutinise the loans to primary producers. The average bank manager is a highly trained business man but he cannot be expected to pass an expert opinion on the advisability of lending money to be expended on certain improvements.

Some may have heard of the Canadian scheme which was set up during the depression. A large number of insurance companies in Canada banded together and called themselves the " Colonisation Finance Corporation of Canada, Limited ". Their object was to improve the farms which had come to them under lien, by improving farming methods, working towards the eradication of weeds, and introducing mixed farming methods. When a farmer was in difficulties, he signed an agreement in consideration of continued assistance or of postponement of legal proceedings. By this he undertook to follow the advice and instructions of the farm managers, and to contribute about two shillings an acre for this privilege.

At the end of 1931, the Corporation had 432 farms under control, comprising about 169,000 acres. Five farm managers were appointed to assist the chief farm manager in the supervisory work. I have not had recent reports on this scheme, but the last report showed that a large percentage of the farmers were not only holding their own, but were paying off some of their back debts.

I am not suggesting that such large scale schemes should be set up in Australia at present, but if it had been in existence during the depression, large sums of money would have been saved, and many properties would not have been abandoned.

The Lack in Victoria.

It would seem that Victoria is the only State without district officers, and without a district farmers' organisation. It has been said that it is impossible to establish a district extension system in Victoria because there is not a supply of suitable officers. This is bringing up the old argument of " the hen and the egg ", and it would appear reasonable to set about training men suitable for this work so that the system could be established. With its establishment would come the consequential establishment of farmers' organisations, and a big increase in the efficiency of the extension work carried out by the

Department. (The Young Farmers' Clubs are not organised by or under the control of the Agricultural Department.)

Another important point is the question of remuneration. As a group of professional men, agricultural scientists probably receive a lower standard of salaries than any other professional body, the standard being kept low by the salaries paid by the Department. While the staff of the Department is continually being weakened by desertions to private firms, there will be no chance of building up a satisfactory organisation. While the commencing salary is more or less satisfactory, it is the yearly contract system and the poor increments offered which aggravate this position. There are indications that the demand for agricultural graduates by outside firms will increase, but I feel that if a successful and efficient extension system is to be built up in Victoria, this will entail a considerable increase in the staff, and it will be necessary to persuade the " powers that be " that money invested in the Department of Agriculture will return a handsome rate of interest.

There are obvious signs that the farmers and graziers in Australia are entering a period when there will be keen competition from primary producers in other parts of the world, and it is only by lowering the cost of production that they will be able to remain financial in the face of this competition. Therefore it is not a case of efficient extension work being desirable, but a case of it being absolutely necessary if the prosperity of Australia is to be maintained.

Plant Regeneration in Areas of Low Rainfall

Report of Addresses given by Dr. H. C. Trumble, Professor J. A. Prescott, Professor J. G. Wood, Dr. J. G. Davies, and Mr. A. G. Lowndes at the April (1938) *meeting of the Agricultural Sciences Club, Waite Research Institute, South Australia.*

Introduction.

The discussion was introduced by Dr. H. C. Trumble, who reviewed the origin and preliminary phases of the work on soil erosion and plant regeneration that has arisen as a result of the Mortlock bequest. The development of this project involves a material withdrawal from the field of pasture research in the higher rainfall areas of South Australia and a major reorientation of the ideas of the investigators concerned.

The fundamental necessity in plant regeneration studies is an investigation of rainfall incidence, degree and effectiveness. It is necessary to define

individual seasonal types and to determine the frequency of their occurrence. Mean values become of less and less significance as the total rainfall decreases, until beyond the twelve-inch or ten-inch isohyet in southern Australia they almost cease to have meaning.

The study of rainfall incidence in relation to associated conditions of atmospheric saturation deficiency or evaporation rate permits the definition of distinct periods of effective rainfall, together with the quantity of rainfall capable of influencing the growth of plants. From this, one must proceed to losses by run off and gains by accumulation ; these are micro-environmental in a sense, but are fundamental to the main problem. The question of penetration and the subsequent fate and availability of soil water then becomes important in relation to the quantities of moisture that can be used.

Utilization of water by plants is governed by root exploration on the one hand and the rate of transpiration on the other. All plants require vast quantities of moisture for growth, the expenditure in many dry land plants approximating fifty to sixty gallons of water per pound of new dry material. The high water requirement of herbage species for normal growth and production indicates that flats and areas of moisture accumulation generally will be the most fruitful areas for investigation.

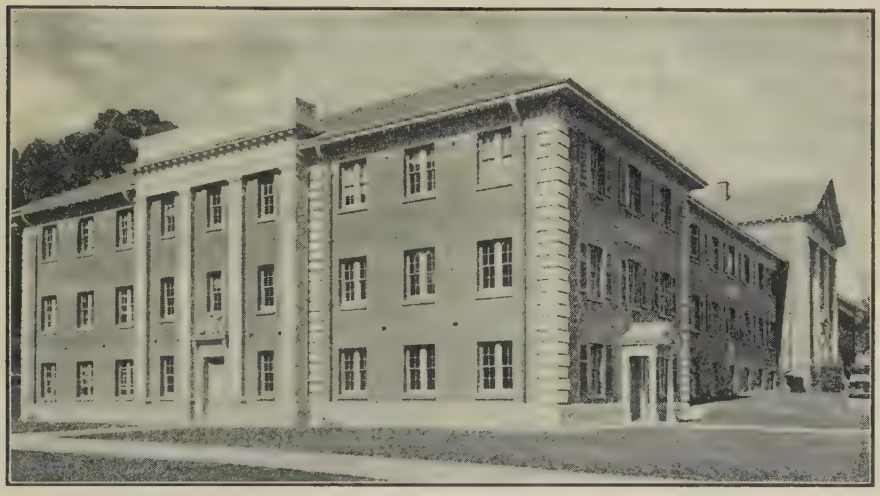
The affected country in South Australia falls naturally into (1) the marginal cultivated areas of the mallee, (2) the northern pastoral areas of shrub-steppe and semi-desert scrub. In the former, soil drift, brought about by the loosening and exposure of the soil under conditions of desiccation for at least seven months of the year, provides a major problem. This involves the establishment of permanent plants on drifting sand and the incorporation of herbage species into existing cropping systems.

Of the northern pastoral areas, extremely little is known as yet by the agricultural investigator. A primary need is an increase in the scope and comprehensiveness of the meteorological data recorded. One must also have a broad general inventory, along ecological lines, of the present condition of the vegetation. A major difficulty lies in the tremendous area of country to be covered ; and one can hope only to take sample areas of a representative nature and observe the effects of management, plough-furrows and seedings of various types. Of these, the investigation of biotic influences is of paramount importance.

Professor J. A. Prescott emphasized the differences in the establishment of plants in the agricultural and pastoral areas. Under conditions of cultivation, the elimination of competition and preparation of a seed bed are readily attainable. In the northern pastoral areas, however, the problem is of an entirely different character, for normal agricultural operations are not generally possible. Prior to the loss of the native vegetation in these areas, the presence of nurse plants and a natural seed bed facilitate plant establishment. Following

the disappearance of the normal plant cover, erosion of the friable surface material results in the loss of surface conditions that are favourable for seed germination and seedling establishment.

These points were illustrated by photographs of the *Spinifex* country in the north-west of Western Australia, showing the type of surface protection and shelter provided by stones and the *Spinifex* bushes themselves ; and by analytical data from non-eroded, undisturbed soil profiles in the north-eastern pastoral areas of South Australia.



The New Ranson Mortlock Laboratory, Waite Research Institute.
Erected for the Investigation of Soil Erosion and Plant Regeneration Problems.

Plant Associations at Koonamore.

Professor J. G. Wood, who has had many years' experience of the northern pastoral areas, made a valuable contribution to the discussion by describing, with the aid of photographs, the principal plant associations of the Koonamore area. He stated that the four main types of habitat to be considered were (1) the hill country of a rocky nature, sparsely vegetated, with poor moisture relationships, and not of great economic value ; (2) the watercourses, characterized by water erosion and ephemeral growth following good rains ; (3) the plains proper, vegetated by Chenopodiaceous shrub-steppe, and of greatest importance ; (4) the sandhills, naturally protected by shrubs of *Acacia*, *Cassia* and *Eremophila*, but readily subject to drift on removal of the dominant cover.

The provision of litter is regarded as being of primary importance in the revegetation of the sandhills. Annual species such as the *Bassia* spp. and certain grasses fulfil this function, and thus enable the slower growing perennials

to establish themselves. Rabbits provide a drastic influence tending to inhibit the establishment of shrubs; and it was found necessary to enclose mulga associations with rabbit-proof netting to permit mulga seedlings to develop. The importance of the surface soil cover was further stressed; exposure of pure travertine and gypsum gave little hope of plant establishment.

Dr. J. G. Davies stated that there are three interrelated phases to which investigation should be directed. The statistical study of climate, with the setting up of strategic and completely equipped meteorological stations is a primary essential. Further attention should be paid to the soils, especially in their relationships to the floristics. Finally there are plant ecological studies in the widest sense of the term with especial attention devoted to the biotic factor. In short a comprehensive study of the plant environment is called for.

Fundamentally there is only one major change in the ecological environment—in the character and intensity of the grazing. It is, thereofore, necessary to realize that erosion is initiated in its drastic form by wrong grazing methods. It is suggested that controlled trials, involving known intensities and modifications of existing grazing practices, be conducted, careful record of the floristic changes being made.

Plant introduction is viewed with extreme reserve, but under favourable conditions the possibility of establishing the endemic species of value is regarded as being more hopeful.

The problem involves the setting up of a new relationship between the flora and its environment. Modifying the effect of stock by control of the grazing is regarded as more practical than modifying the flora to meet the changed environmental conditions.

Mr. A. G. Lowndes, Land Utilization Officer of the Bank of New South Wales, stressed the importance of management in relation to soil erosion problems, and classified the various forms of erosion into four main types: (1) deterioration due to over-grazing of the pastoral areas; (2) soil drift in the areas of marginal cultivation; (3) water erosion in the agricultural districts of more liberal rainfall; (4) the erosion of high rainfall mountainous country, leading to the silting of catchment areas.

The meeting concluded with an exhibit, by Mr. T. T. Colquhoun, of a large Watson microscope, with numerous accessories, which has been presented to the Waite Institute by Mr. H. Showell of Medindie. The equipment, which is valued on present prices at more than £300, is suitable for photomicrography and projection work.

Some Economic Considerations Arising from a Study of Plant Pathology*

By

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Many are the instances which have been quoted by plant pathologists in various countries to illustrate the damage caused by the ravages of disease in economic crops. But there are two possible criticisms which perhaps might be raised at this juncture :

Firstly, that the monetary values placed on crop losses are purely nominal, inasmuch as if the losses had not occurred the monetary value of the total production would have been no greater than it was for the part, because values per unit of production would have fallen to the point where the same total amount of money would have purchased the new total of production. The truth of this contention would appear to hinge on whether an internal or external market is being supplied, whether or not trade restrictions are operative, and on the proportion of the total world or local market supply represented by the reduction caused through disease. Nevertheless, taking a world view, there is probably a considerable amount of truth in this contention. What, however, cannot be denied is that crop losses due to disease or any other catastrophe such as drought, fire, hail, or flood represent an enormous wastage of human effort.

Because of the ravages of rust, smut, root-rots and all the other diseases affecting wheat crops, the amount of human effort which has to be expended every year to raise a given quantity of wheat as food for the world is enormously increased over what would otherwise be required.

For example, it has been shown that over the period 1925-32 (eight years) the losses in western Canada from black stem rust of wheat alone averaged 37,396,000 bushels.

During the same period in Western Australia, the average yield for the whole State was 34,961,751 bushels. In other words, the world as a whole would have been as well off, so far as total wheat production was concerned, if the whole of the wheat farmers (about 10,000 owners) in this State had taken an eight-years holiday, provided only that the ravages of black stem rust in Canada could have been, with certainty, eliminated over the period.

The field for extension of plant pathology so as to conserve human effort, therefore, is tremendous, especially as much the same sort of considerations applies to almost all cultivated crops.

* Extracts from Presidential Address to the W.A. Branch of the Institute on April 1, 1938.

The *second* criticism is perhaps more important and is that plant pathology, if given its head, would soon plunge the world deeper, than it recently was, in the throes of overproduction of primary products.

Any criticism of plant pathology along these lines is only a specific case of the broad general argument that can be brought against agricultural science in general, and be it not overlooked, also against fertiliser firms, machinery firms, improved transport facilities, and so forth.

To be consistent and logical, those who advance such arguments must also argue in favour of the absurd position that with the acquisition of knowledge and superior techniques, farmers should migrate from areas containing rich, fertile soil to those noted for their infertility, so that overproduction and the " drift to the cities " may be avoided !

Taking a broad, philosophical point of view it is desirable, in the interests of the community's well-being, that as few persons as possible shall be required to produce the food and staple fibres and other primary products required for the nation. Today is the day of mechanisation and of secondary industries. Primary industries make life possible, but for most people it is the products of secondary industries which make life worth living.

Mr. C. H. Wickens, late Commonwealth Statistician, in a most interesting article dealing with the relative significance of primary and secondary production, pointed out some years ago that the figures available for Australia for a range of 50 years indicated a decline in the proportion of breadwinners engaged in primary production from 44 per cent. in 1871 to 26 per cent. in 1921. He stated : " We have here a feature not unusual in any modern community increasing in numbers fairly rapidly, viz., a decline with time in the proportion, if not indeed in the number, of breadwinners engaged in primary production. Great Britain, the U.S.A. and Germany have all exhibited similar declines, and the figures available for the U.S.A. for a long range of years are very striking, and show for breadwinners engaged in agriculture a decline from 87 per cent. of total breadwinners in 1820 to 26 per cent. in 1920 ", and yet the standard of living of the average citizen of the United States obviously increased enormously during that period.

Plant Disease Position Not Static.

An important point in connection with all plant pathological considerations is that the plant disease position is not static. There is ample evidence that some parasites at least are in a process of change. Hybridisation and the evolution of new types of fungi, for example, is possible, and is actually taking place between strains and species. Good examples of this occur in the case of the parasites responsible for bunt in wheat, loose and covered smuts in oats, flagsmut in wheat, rusts, etc., and new forms are arising, many of which have new capabilities of causing disease. Well over a hundred distinct strains of

Puccinia graminis tritici are now known. Although the battle today may in some cases be with the scientist, there is no knowing what tomorrow may bring forth, and the position may quickly be reversed in the absence of eternal vigilance and progressive policy. Today, as always, eternal vigilance is the price of freedom. The virus diseases alone constitute a sort of simmering volcano which may cause even greater alarm in the future than they have in the past.

At the present day a great amount of attention is being given, the world over, to the tremendously important problem of human nutrition. Nations and individuals are being admonished to eat more vegetables, drink more orange juice.

Now it is frequently quite erroneously stated that the chemical analysis of lettuce is so and so, orange juice this and that, beetroot one thing and another. In actual fact the exact composition of all plant products is to some extent a function of the type and chemical properties of the soils on which they are grown. If, for example, oranges are grown on a soil deficient in copper or zinc, the general well-being of the community will be impaired, as the orange juice will be deficient in zinc and copper—the former fulfilling an important function in human physiology.

Plant pathology is concerned with the symptoms shown by such unhealthy plants, and enables the correct remedies to be applied to bring the plants and consequently the community, into a renewed state of health.

Sir John Russell has stated that it is unlikely that the total loss caused by plant diseases and pests is less than £15,000,000 to £20,000,000 a year in Great Britain, and that the " present expenditure on agricultural research and advisory work, which comes to rather more than one-halfpenny per pound sterling of the value of the crops raised, would be a good investment even if all the money were devoted to the study of plant diseases ".

With developments in other branches of agricultural science, there arises a necessity for an accelerated study of plant pathology and extensions in its scope, as many of the factors which tend to give increased yields tend also to increase, sooner or later, the ravages of plant diseases and insect pests.

Agricultural science, indeed all sciences, inventions and advances in knowledge and techniques, increase national well-being, but undoubtedly create difficulties of adjustment in the political, economic and sociological aspects of government, varying in intensity with the rate of progress. It is our duty as scientific workers to accelerate the wheels of progress ; it is our duty as citizens to endeavour to assist in smoothing out those difficulties which we are helping to create.

Some Principles Affecting the Introduction of Plants

By

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As a preliminary to any discussion of the principles affecting the introduction of plants, it is necessary to investigate to some extent the soundness of or justification for this line of scientific endeavour. While it is true that the endemic flora of Australia represents the climax of the struggle of ages between plant life and its complex environment, it is equally true that numerous exotic plants have become acclimatized here. Indeed, there are many instances of plants, introduced accidentally or otherwise, having adapted themselves so well to the new environment that they have actually taken possession of land formerly dominated by native flora. There is thus no question as to the ability of certain exotic plants to adapt themselves to the Australian environment. The fact that present-day Australian agriculture depends so much for its success upon introduced plants of all kinds is in itself sufficient justification for the prosecution of organized search in other countries for additional superior plants to augment the country's resources in general and to meet definite needs in particular.

Principles Enunciated by Vavilov.

The principles which govern, or should govern, the search for and introduction of plants depend for the most part upon the objective behind the quest and its fulfilment. In this connection there are the principles enunciated by N. I. Vavilov, of special interest to the plant breeder, which are worthy of review at this stage. Vavilov in his article " Geographical Regularities in the Distribution of the Genes of Cultivated Plants " (*Bulletin of Applied Botany of Genetics and Plant-Breeding*, XVIIth Volume, No. 3, 1927) stresses the importance to the plant breeder of the focuses* where different cultivated plants originated. These geographical centres of diversity, he claims, are of practical value in that they represent a rich stock of dominant and recessive genes from which the plant breeder must eventually choose what is of interest to him, leaving the most frequent dominant forms which prevail in the native country by reason of free combination.

In his study of the distribution of the botanical varieties of cultivated plants throughout the world, and in his endeavour to locate the focuses where

* Vavilov uses " focuses " instead of " foci ".

different cultivated plants have originated, Vavilov lays claim to having ascertained geographical centres which embrace diversity of phenotypes. He further claims that detailed study of the racial composition of the separate Linnean species has established systems of characters, corresponding to a certain degree to systems of genes, and the geographical regions of their concentration. Direct study of the centres of the origin of cultivated plants, undertaken by expeditions in the mountainous regions of Asia and Africa, in the countries bordering on the Mediterranean and in Transcaucasia revealed, he avers, not only a great diversity of forms but also a prevailing accumulation of dominant forms characterized by dominant genes in the centres of the regions named. A considerable number of plants investigated revealed this regularity. Five principal geographical centres of origin of cultivated plants were established :

1. South-western Asia.
2. The mountainous part of China.
3. The mountainous regions of the Mediterranean coast.
4. Mountainous East Africa (Abyssinia and Eritrea).
5. The mountainous regions of the New World (Mexico, Guatemala, Peru, Columbia).

To these principal centres of the origin of cultivated plants must be added, in his opinion, certain secondary zones, as for example the Asiatic island centre (Japan, Java, Sumatra, etc.).

Despite the diversity of phenotypes and the concentration of genes found in these geographical focuses and probable centres of origin, there are not always found there the phenotypes which are necessary to man. For example, the wheats and barleys of Abyssinia, though characterized by an extreme abundance of genes, are in themselves of no practical interest to the European plant breeder. The reasons for this are that an overwhelming majority of races in Abyssinia and Eritrea correspond, as a result of natural selection, to the short equatorial day types and that the majority of races in mountainous East Africa are spring forms and poorly tillered.

Vavilov states further that it is very probable that the most interesting combinations for European cultivation are the recessive ones, the recessive genes. The cultivated type is the recessive type. He contends that it is the building material that is required by the plant breeder, but that it lies with him to create necessary combinations.

From a general cultural-historical point of view, the process of concentration of dominant genes at focuses and their diminution toward the periphery is a positive process, and the operation of this process has given rise in the course of time to the great cultures of northern Europe, in his opinion. Being recessive in the composition of their genes, they have brought under their

control the potentially richer conglomerates of genes of the initial peoples living in the primary seats of human culture.

Vavilov concludes his interesting article by stating that so far the geneticist has left almost untouched a field that promises to reveal facts of first-rate importance for the understanding of the evolution of the separate Linnean species.

Plant Introduction Work in Australia.

The principles enunciated by the Russian scientist, briefly outlined above, are apparently intimately connected with the introduction of plants, more especially those required for use in plant breeding. Until such time as these principles and their practical application have been more fully studied, and verified by other workers, the principles involved in the following briefly-outlined procedure in general followed here in Australia should suffice for present requirements.

Constant endeavour, as yet almost entirely by correspondence, has been and is being made to procure more productive and locally-adaptable plants from more or less similar environments or homoclimes (after Griffith Taylor) in other parts of the world, taking into consideration as far as possible such environmental factors as latitude, rainfall (total and seasonal distribution), evaporation, elevation and edaphic conditions. The following will serve to illustrate to some extent what is meant.

For use in the " Mediterranean Zone " of Australia productive, palatable and adaptable grasses and legumes are being sought in countries possessing " Mediterranean " climates.

Self-regenerating legumes suitable for enriching the legume-deficient (hence protein-deficient) pastures of sub-tropical and tropical Australia are being sought in countries of more or less similar climate to that obtaining in the north-eastern and northern areas of the Commonwealth.

Countries with low or comparatively low rainfall in approximately the same latitude, in both hemispheres, as that in which Australia lies are being given attention in the hope of finding therein useful grasses and other plants capable of growing in moderately light rainfall areas of the Commonwealth.

Plants of various kinds from other countries with rainfalls and other climatic conditions resembling, if not the equivalent of, those prevailing in various zones in Australia are being sought with the object of endeavouring to meet specific needs.

Australian Citrus Fruits

HANDLING AND STORAGE IN RELATION TO WASTAGE.*

By

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Introduction.

In Australia, varieties of the sweet orange (*Citrus sinensis*) are of principal importance, the chief being Washington Navels and Valencias. In the coastal areas of New South Wales common oranges are also grown, the varieties being Parramattas, Joppas and Silettas. The production of common oranges is, however, decreasing and they are not now of much importance. Grapefruit, lemons and mandarins are also grown, the latter in the coastal areas of New South Wales and Queensland. In New South Wales the Emperor mandarin is the only variety of importance. New South Wales is the principal producing State, producing about sixty per cent. of the Australian total citrus crop of 5,000,000 bushels. The main areas of production are the central coastal region of New South Wales, the inland Murrumbidgee Irrigation Area and the irrigated areas along the Murray Valley in South Australia, Victoria and New South Wales. The Adelaide Plains area in South Australia is also of importance. Navel oranges are harvested from May to August, and Valencias from late July to March. The latter, however, are only picked before September for export.

Wardlaw[10] says :

> " Although the genus is primarily of tropical origin the largest producing areas actually lie outside the tropics. Citrus fruits are thus grown under a wide range of cultural conditions in all five continents, from moist tropical regions of uniformly high temperature to subtropical and warm temperate regions where trees may occasionally suffer from frost injury. Since environment influences not only the growth of the plant but also the physiological behaviour of the fruit after it has been harvested, diversity rather than uniformity characterises the storage requirements of citrus produced in different countries."

In experiments on the storage of Australian citrus fruit, a similar diversity in storage behaviour has been found not only between inland irrigated and coastal areas which are radically different in climate, but also between different orchards in the one locality. This variability extends even to different trees in the one orchard and to individual fruits on the one tree.

Less than ten per cent. of Australia's production is exported, principally to New Zealand, though in some years a considerable quantity has been sent to the United Kingdom where, however, wastage has often been high. The

* Much of the subject matter of this article is the outcome of three years' investigation conducted jointly by the C.S.I.R. Citrus Preservation Committee and the N.S.W. Dept. of Agriculture.

fruit is carried to England in refrigerated storage, the duration of the voyage being approximately six weeks. Wastage has been due to low temperature injury and to mould attack, and has been a big factor in preventing the development of export of Australian oranges to distant markets. Wastage in fruit sent to New Zealand, in spite of the fact that the bulk of it is carried in unrefrigerated holds, has rarely been excessive. While very little fruit is cool stored for local marketing, wastage is important in fruit marketed in Australia, in this case being due to fungal rotting—principally green mould—and to wilting resulting in loss of condition.

Types of Wastage.

In stored citrus there are three major types of wastage :

(i) Fungal wastage, rots and spots of various types.

(ii) Physiological rind blemishes, principally due to low temperature injury.

(iii) Blemishing and deterioration in condition due to loss of moisture from the fruit.

Fourthly, in long storage decline in palatability and staling of the juice often become important.

(1) *Fungal Wastage.* In Australia, as in most other citrus producing countries, the common green mould (*Penicillium digitatum*) is the most important. This is a soft rot, in the later stages usually involving the entire fruit and forming olive-green powdery masses of spores on the surface. The blue mould (*P. italicum*) also occurs but, except in isolated cases, is only of small importance ; it, however, is more common on mandarins than on oranges. Both of these moulds are wound parasites, and grow rapidly at favourable temperatures.

Stem-end rots are next in importance. These are firmer, somewhat pliable rots beginning as a gradual discolouration advancing from the stem-end in various shades of drab and brown. They will eventually involve the whole of the fruit but are much slower developing rots than those caused by the green and blue moulds. Stem-end rots are produced typically by *Phomopsis citri* and *Diplodia natalensis*, the latter being less important in Australia. In local experiments, similar rots have been found to be caused by *Alternaria* and *Botrytis* spp. They are often a major cause of wastage in coastal fruit.

A black centre rot caused by *Alternaria* sp. also occurs but is more common in mandarins than in oranges. It generally proceeds down the centre of the fruit with little or no external evidence of its presence. Sometimes in Navel oranges *Alternaria* infection takes the form of a navel-end rot. This latter rot commonly occurs on the tree and causes the fruit to colour and drop prematurely.

Button rots occur during storage at higher temperatures and after cool storage at temperatures of 45° F. and below. These are minor rots at the stem end, which are distinct from stem-end rots as they do not spread laterally through the rind but are confined superficially to a small area around the button. They often penetrate deeply into the fruit down the central vasculars. Fungi commonly associated with these lesions are *Colletotrichum*, *Alternaria* and *Fusarium* spp. The proportion of cases in which these are primary parasites, or secondary following an initial physiological button storage spot has not yet been fully determined.

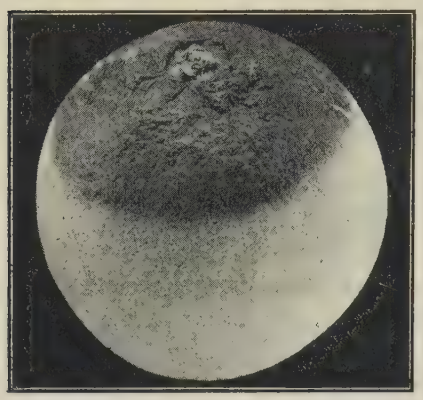
In addition to definite rots, fungi may cause spots on the rind. In severe cases, generally as a result of secondary infection, these spots may become somewhat rotted.

Those of principal importance are black spot caused by *Phoma citricarpa* and Septoria spot caused by *Septoria citricola*. *Colletotrichum* may also cause a circular, brown, depressed and firm spot on the rind. Black spot is primarily an orchard disease but will develop in store at favourable temperatures and often develops and increases greatly between picking and marketing. It is one of the most serious diseases on fruit in the coastal districts of New South Wales, principally affecting Valencias as this variety matures during the summer when temperatures are favourable to its development. Typically, small reddish brown spots appear on the rind ; these later sink, enlarge and become almost black in colour. In severe cases, the lesions are more irregular and more brown in colour, much of the rind surface often becoming involved.

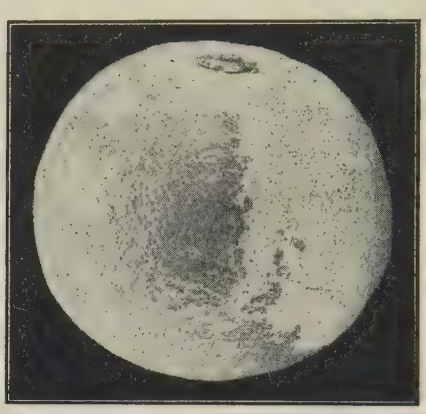
Septoria spot is very similar to black spot in its symptoms and behaviour after picking ; it also is primarily an orchard disease but principally attacks Navels. Black spot is of serious importance in New South Wales and Queensland coastal areas, whereas Septoria spot is most severe in the Murray Valley and has not been recorded from the above coastal regions.

(2) *Physiological Rind Blemishes*. Of these, storage spot is the most important. It is similar to the rind disorders in stored fruit referred to by workers in other parts of the world as storage pox or pitting. It occurs almost universally on oranges and grapefruit stored at relatively low temperatures. Storage spot consists of discoloured areas on the rind, generally more or less sunken and more or less irregular in outline. The colour of the lesions may range from light honey coloured to dark brown. These spots are firm and dry and usually involve only the outer portion of the rind. They may occur anywhere on the rind but are often most commonly situated at the stem end around the button. In Australian work this disorder has been separated into two classes, button storage spot, and lateral storage spot, as in the former fungi have been found to be involved and thus it may not be entirely physiological in origin. The latter seems to be wholly physiological as fungi have not been isolated from these lesions.

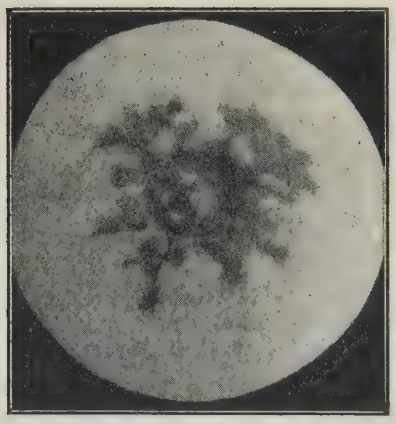
Storage spot is most common at temperatures from 37° to 45° F. At lower temperatures, cold injury takes another form which is commonly called cold scald.



Stem End Rot on Washington Navel Orange.



Cold Scald on Washington Navel Orange at 36° F.



Button Storage Spot on Washington Navel Orange at 45° F.

Lateral Storage Spot on Washington Navel Orange at 45° F.

Cold scald takes the form of a relatively large superficial or slightly sunken area which is lighter in colour than typical storage spot and, by comparison, is not sunken. It often has a slightly pitted appearance within the lesion. It is not of great commercial importance as in commercial storage and overseas carriage the temperatures range from 38° to 42° F. which are above the temperatures at which cold scald develops. The appearance of cold scald is

a sure sign that the fruit has been subjected to temperatures approaching freezing point.

Other rind disorders such as flavocellosis, gooseflesh, glazed scab and darkening of the oil glands also occur in storage but are generally only of minor importance. Darkening of the oil glands has been found to be more common in mandarins than in oranges, and is associated with the end of the senescent period.

(3) *Moisture Loss and Wilting of the Fruit.* After picking from the tree, moisture lost from the fruit as a result of its normal life processes is not replaced, and this loss soon becomes manifest in the development of a wilted, unattractive appearance. Under certain conditions the fruit may also develop discoloured desiccation blemishes on the rind.

(4) *Loss of Palatability.* The palatability of an orange is the result of the combination of taste and flavour. The acidity and sugar content together produce the taste, and the degree of orange flavour possessed by the fruit is due to the presence of certain, as yet unknown, volatile constituents. In addition to normal orange flavour, stale and " off " or foreign flavours may develop in store. It has generally been found, however, that fungal wastage and rind disorders set a limit to the storage life before loss of palatability becomes important.

Handling and Wastage.

The way in which the fruit is handled from picking onwards, particularly in regard to wounding and sanitation, has an important bearing on wastage. The following is a summary of the more successful of the methods available for improving the storage life of the fruit. These methods have not yet been fully adopted by Australian citrus packing houses.

Picking. Prior to harvesting and during the several processes between picking and marketing, the fruits are liable to mechanical and physiological injury and to fungal invasion. The importance of careful handling cannot be over-emphasized. The ubiquitous green mould is a wound parasite and any mechanical injury to the fruit will serve as an avenue for infection.

Orchard sanitation is important in relation to wastage. Pruning out dead wood, spraying and the maintenance of a good standard of orchard cultivation have been shown to be important in the control of certain forms of wastage, particularly stem-end rot.[8]

In order to avoid injury, oranges and lemons should be clipped from the trees with special clippers, while mandarins may be pulled, and grapefruit either pulled or clipped. Under the best conditions of handling, the fruit is also picked into special bags, filled into field boxes and transported to the packing shed for treatment and packing. In picking, gloves should be worn to minimize injury to the fruit and a layer of wood wool should be placed in the

bottom of the field box to further reduce injury. Recent investigations by Winston[12] working with grapefruit indicate that, under certain conditions where stem-end rot is likely to be severe, pulling the fruit is more satisfactory than clipping. The removal of the button removes infections harboured in and about the stem at its point of attachment to the fruit, and this reduces the incidence of stem-end rot. Picking should not be carried out while the trees are wet with dew or immediately after rain, as the then turgid fruits are easily injured and the oil liberated from the rind, particularly early in the season, may cause a characteristic brown spotting known as " oleocellosis."[2] These blemishes and injuries predispose the fruit to subsequent rotting.

Most of the New South Wales coastal fruit, however, is sold locally on the Sydney market and the greater proportion of this is pulled and packed on the orchard, without being processed in an equipped packing shed.

Sweating and Colouring. After picking, fruit, if it is intended for export or storage, is commonly wilted for a few days before being packed. The effect on subsequent wastage of sweating Australian fruit has been variable. In regard to mould control, any value lies in toughening the rind and in drying out small wounds. Overseas investigations with oranges have given conflicting results but, in the case of grapefruit, sweating for ten days at 70° F. has been shown to reduce pitting considerably during subsequent storage at susceptible temperatures.[5] [6]

Recent experiments with Australian navels indicate that both sweating for several days at 70° F. and for a few hours at 100° F. with a low humidity may be effective in controlling storage spot.

Early Navels and late picked Valencias are often somewhat green in colour, the former on account of immaturity and the latter because of regreening as a result of renewed vegetative activity. This fruit can be coloured by the use of ethylene gas under appropriate conditions. For satisfactory colouring, oranges are treated for two to three days with ethylene at a concentration of 1 : 5000 at a temperature of 75° F. and a humidity of 85-90 per cent. These conditions are ideal for the growth of fungi so that the colouring process often increases subsequent wastage ; it is generally considered to weaken the fruit. To minimise this effect it is recommended that fruit be treated with borax as soon as possible after picking and before going into the colouring room. Borax is an effective fungicide against green mould.

Processing. After sweating or colouring where necessary, the fruit is processed, firstly being washed to remove superficial dirt and certain superficial fungal pathogens of the rind which are common in coastal areas and spoil the appearance of the fruit. In washing, various alkaline cleaning compounds are used, the fruit passing through a warm cleaning solution and then over brushes under a water spray where the loosened dirt is removed. The fruit is then passed through a tank containing a fungicidal solution, after which it is

dried and polished. In the complete process, the fruit is also given a coat of wax. Careful handling and strict attention to sanitation are very important in the packing shed ; it has often been found that owing to faulty methods treatment in a packing shed increases wastage due to green mould.

In New South Wales experiments, coupled with commercial experience, a one per cent. solution of a mixture of sodium metasilicate and soap powder has been found to be an effective detergent. Numerous materials have been tried both experimentally and commercially for processing to reduce fungal wastage. Of the large number tried, borax in concentrations of five to eight per cent. at 110° to 120° F. is the only one which has given consistent control of green mould. It also reduces the incidence of stem-end rots but is relatively ineffective against blue mould. A one per cent. solution of caustic soda or a three per cent. solution of sodium bicarbonate gives good control of blue mould, but not of the more important green mould. The use of borax, unless followed by waxing, increases shrinkage of the fruit and also tends to increase the incidence of storage spot, particularly that at the button, although results here have been somewhat variable (cf. Benton and Robinson[1]). This effect is more apparent early in the season when wilting is more pronounced and the fruit more susceptible to storage spot. There has been a great deal of work carried out in various countries on the use of disinfectants, particularly borax. In a recent investigation of the use of borax, Winston[11] showed that best results were obtained when the fruit was dipped as soon as possible after picking, this treatment also giving a partial control of stem-end rot. The film of borax solution remaining on the fruit should also be allowed to dry slowly.

A temperature of 120° F. for two to four minutes is cited by Fawcett[3] as the danger point for fruit immersed in such processing solutions. In the case of immature and very turgid fruit, particularly lemons, the temperature may have to be reduced to 95° F. to avoid hot water injury. The efficiency of disinfectants and detergent solutions increases with rise in temperature. The temperature tolerance of fruit depends largely upon its maturity. With mature fruit from the New South Wales coastal districts, experimental processing has been carried out at 115° F. for three minutes and in no instances has any injury resulted.

A method of treating citrus fruit with nitrogen trichloride gas (Decco method) has been developed and used in Californian packing sheds for the control of *Penicillium* rots.[7] In a local experiment the use of this gas was found to control *Penicillium* except in fruit artificially inoculated with a spore mixture, but it did not affect wastage due to stem-end rot. However, the process is covered by patents and the controlling American company is not at present willing to extend its activities to Australia.

Waxing. Waxing of the fruit before packing has become a standard commercial practice in most citrus producing countries. The application of a thin film of wax to the fruit maintains it in good condition by reducing shrinkage, imparts a lasting lustre and aids in the prevention of wastage. In early experiments, waxing was carried out by spraying the fruit with a solution of paraffin wax in kerosene but this did not prove satisfactory, largely because of difficulty in maintaining the wax in solution and also because a lasting lustre was not obtained. The kerosene was also readily absorbed by the fruit. The waxing of citrus fruits has largely been developed in America and two satisfactory methods have been evolved. In the " cold slab " method, horse hair polishing brushes revolve over a slab of wax and transfer the wax to the fruit passing over them. The other method is the Brogdex process, in which the polishing brushes are enclosed in a heated chamber and a fine spray of a molten mixture of paraffin and carnauba wax is introduced in the form of a wax fog. This settles on the fruit and is brushed over to a uniform thin coating by the revolving polishing brushes on the floor of the chamber. Carnauba wax is a hard wax and its addition imparts a permanent lustre to the fruit. The use of a borax bath followed by waxing is a standard processing treatment in America.

Previous attempts to wax oranges on a commercial scale in Australia have been unsatisfactory and waxing was discontinued by the few sheds which had installed waxing plants. In cooperation with one of the coastal packing sheds, their plant was modified so that fruit could be waxed in a satisfactory manner. A modified " hot fog " method was adopted and results have been very satisfactory both in experimental lots and on a commercial scale.

The treatment of coastal fruit with borax and wax has greatly reduced wastage due to green mould, given some control of stem-end rot and has maintained the fruit in good condition for long periods. It should be pointed out, however, that under the British Health Regulations borax cannot be used on fruit exported to the United Kingdom.

Wrapping. In experiments with local fruits wrapping materials of various types have been tried both as individual fruit wraps and as case liners for the purpose of maintaining condition and reducing wastage. An efficient wrap must exert an effective control of mould without inducing rind spotting in store, prevent contact spread of rots, reduce moisture loss and be capable of ready manipulation. Wraps treated with iodine and also diphenyl treated wraps have been successful in reducing decay, but the use of these materials is not favoured by the public health authorities. Stahl and Fifield[9] working in Florida, found that moisture-proof wraps were superior to all others in reducing loss in weight and preserving general appearance. The various wraps had no effect on decays but many of them, particularly semi-moisture-proof

cellophane, considerably reduced pitting in stored fruit. The box liner was found to be as efficient as individual wrappers and was much less costly.

In local experiments the use of bitumenized paper ("Sisalkraft") and cellophane case liners with fruit treated with borax has maintained condition and reduced wastage. A slight off-flavour was noticed when the cases were opened after storage, but this disappeared after two days at ordinary temperatures.

Throughout the investigations into the preservation of citrus being carried out in New South Wales it has been apparent that inland fruit is of better keeping quality than that from the more humid coastal areas. Coastal fruit has consistently developed a greater amount of mould wastage than has inland fruit. This was originally thought to be due to a difference in resistance to decay, but it has been shown that the greater amount of mould wastage experienced in coastal fruit, particularly in that from the Gosford lowlands, is not due to any inherent factor but rather that in the coastal districts greater opportunity for infection occurs.

Green mould is a big problem in coastal areas and its incidence is governed by pre-storage factors of which mechanical injury after picking and contamination by mould spores are of the greatest importance. Strict attention to care in handling and to sanitation during all processes from picking to packing will reduce *Penicillium* wastage to the level of a minor problem.

Storage Factors.

Variety. The variety and type of fruit affect the keeping quality to a considerable degree. Under optimum conditions Valencias keep longer than Washington Navels, although at susceptible temperatures the former are more subject to storage spot. Common oranges, particularly Silettas, are more susceptible to storage spot than either Valencias or Navels, so much so that they cannot be recommended for export to England. The Emperor mandarin has a shorter life than Navels or Valencias ; it also breaks down more rapidly after removal from cold store. The Ellendale variety which is a later maturing, more solid type of mandarin than the Emperor keeps much better. Mandarins are less susceptible to storage spot than are oranges. Grapefruit are particularly susceptible to storage spot or pitting and keep much better at higher temperatures.

Maturity. The maturity at which the fruit is picked is of greatest importance in determining the conditions under which fruit should be stored and the length of life to be expected. Fungal wastage or decay is least in fruit picked early, and increases with increasing maturity at picking as the season advances. This is due to the fact that as a fruit ages its resistance to the fungi causing decay decreases. On the other hand, susceptibility to storage spot is

greatest in the early picked fruit and decreases with increasing maturity. Owing to the fact that they are picked early, storage spot has been the principal form of wastage in exported Valencias. The effect of maturity on storage life depends on the interrelation of three factors :

(i) Decrease in storage spot with increasing maturity.
(ii) Increase in fungal wastage with increasing maturity.
(iii) The decline in palatability which is more rapid in the later picked fruit.

As storage spot is most prevalent at lower temperatures, and as fungal wastage and the rate of decline of palatability are reduced by lowering the storage temperature, the question of maturity is obviously bound up with that of temperature. However, for satisfactory cool storage Navels should not be picked before June or Valencias before September because of initial low palatability and liability to storage spot. In the case of mandarins from the Hawkesbury River, which is the chief producing area, the best picking time seems to be early June.

Temperature. Investigations in different countries on storage temperatures for citrus show a considerable range ; the earlier experiments were carried out at low temperatures but as knowledge of low temperature injury has progressed higher temperatures have been recommended. For example, several years ago temperatures below 40° F. were recommended for grapefruit, whereas now most workers recommend temperatures of the order of 50° F. In Australian experiments 50° F. has been shown to be more effective than lower temperatures for grapefruit.

In local experiments, fruit has been stored at a range of temperatures and it has been found that storage spot can be controlled at 50° F. but at that temperature stem-end rot may develop considerably. At 36° F. the development of fungal wastage is almost inhibited but low temperature injury to the rind is generally severe. Early picked fruit which is resistant to fungal attack should be stored at a higher temperature to avoid storage spot and improve palatability, while late picked fruit which is less susceptible to storage spot should be stored at a lower temperature to reduce fungal wastage and maintain palatability. It has frequently been observed that the development of button storage spot predisposes to the development of green mould on removal from store, so that after a period of post-storage at room temperatures there may be less mould in fruit stored at a higher than at a lower temperature.

At 50° F. early picked fruit will develop a good orange colour and improve in palatability, whereas such changes will not occur at 36° F. and are very slow at 40° F.

At the higher temperatures, fruit wilts and loses condition more rapidly but this can be overcome by the use of wax and various types of wraps and case liners. The optimum temperature for storage also depends on the pre-

storage treatment. In the case of grapefruit, if the fruit is sweated for ten days at 70° F. it can be stored at temperatures below 40° F. without pitting becoming serious.[4] If the sweating of Australian fruit can be shown to control storage spot, lower storage temperatures can be used and a longer life obtained. The best temperature at which to store the different varieties has not yet been fully determined, as results of experiments so far carried out have been somewhat conflicting. In the case of untreated fruit it seems, however, that the best general temperature for mandarins may be 40° F., for Valencias 45° F. and for Navels probably 45° F. for the early June pick and 40° F. for that picked later.

In regard to humidity in the store, it should be as high as possible to reduce wilting but not so high as to encourage fungal development. The general consensus of opinion is that the optimum humidity is 85-90 per cent.

Gas Storage. Victorian experiments have shown that "gas storage" has no advantage over ordinary cold storage in the case of oranges. By "gas storage" in this instance is meant storage in an atmosphere containing 5-10 per cent. carbon dioxide and correspondingly 16-11 per cent. oxygen, produced by controlled ventilation. However, in experiments on the control of pitting in grapefruit Brooks and McCulloch[2] found that a short exposure to a high concentration of carbon dioxide at ordinary temperatures considerably reduced the amount of pitting subsequently developing in cold store.

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TECHNICAL NOTES

THE pH OF N.S.W. BUTTER AND ITS RELATIONSHIP TO BACTERIAL AND YEAST COUNTS.

Observations have been made in this laboratory during the past eighteen months on the pH of the serum of locally manufactured butter with a view to determining the possible existence of a relationship between this factor and the bacterial and yeast counts. The results of the examination carried out so far are of some interest in so far as they show that the pH of New South Wales butter is higher than previous reports on Australian butters would suggest. For instance, Loftus-Hills, Scharp and Bellair (cf. Jour. Dairy Research 5 : 124-136, 1933) in a study of 70 Victorian butters in 1933 found that 55 of the samples had pH's ranging between 6·0 and 7·5 whilst 26 of these lay between 6·0 and 6·5. In the present instance the majority of the samples examined had pH values in the vicinity of 7·4.

The butters examined were taken chiefly from choicest quality consignments submitted for export. They were all from New South Wales factories, and the samples generally were taken within a fortnight of the date of manufacture of the butter. 114 of the total of 183 butters were amended from choicest brand to first grade owing to flavour defects, but all the samples have been grouped for general consideration as it was considered that the method of manufacture would be the same.

In the routine examinations, after a small quantity of butter had been taken aseptically from the centre of the plug for biological examination, the remainder (two or three ozs.) was melted down in a wide bore test tube and kept at 60° C. for 30 minutes. The serum was extracted with a pipette and the pH determined with a quinhydrone electrode and a Cambridge portable potentiometer. Regular checking with Sorensen's phosphate buffer mixtures showed the instrument and electrodes to be accurate to within 0·02 pH between pH 5 and 7 and to within 0·04 pH up to pH 8. In presenting the results, all samples have been taken to the nearest 0·1 pH.

The results are tabulated in Table 1, and are presented in diagrammatic form in Figure 1. It will be seen that the modal value is pH 7·4 and that the majority of the samples range between 7·0 and 7·7. Only 24 samples out of a total of 183 had a pH of less than 7·0 whilst the lowest value found was pH 6·4. A surprising feature is that some of the choicest butters had values of pH 8·0 and beyond. The diagrams for the choicest and amended butters taken separately are very similar and reveal no differences from the grouped results.

pH and Bacterial and Yeast Counts.

The bacterial counts were taken by plating at a dilution of 1/1000 in nutrient agar+1 per cent. milk and incubating for 5 days at 30° C. For the yeast counts, a 1/10 dilution was plated with acidified Beer Wort agar and

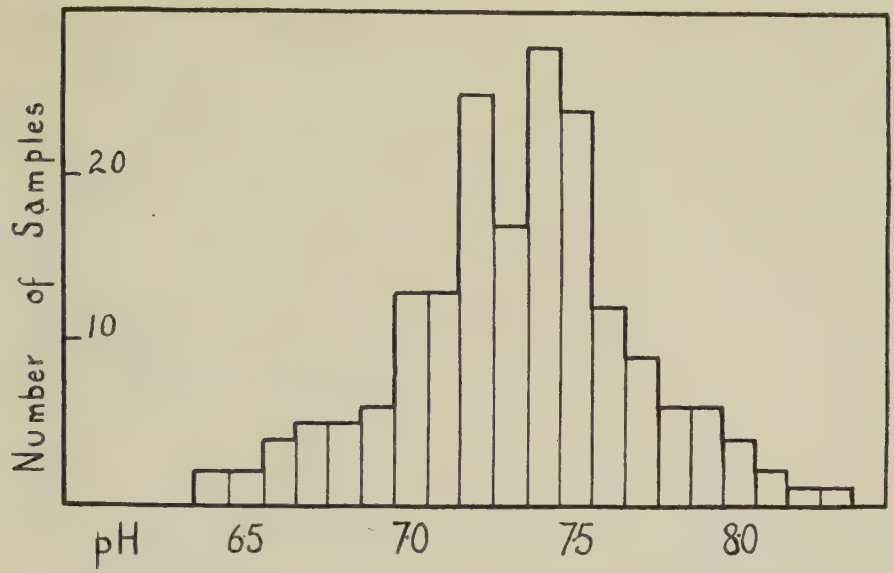

Fig. 1.—*Chart showing distribution of the 183 butter samples according to pH.*

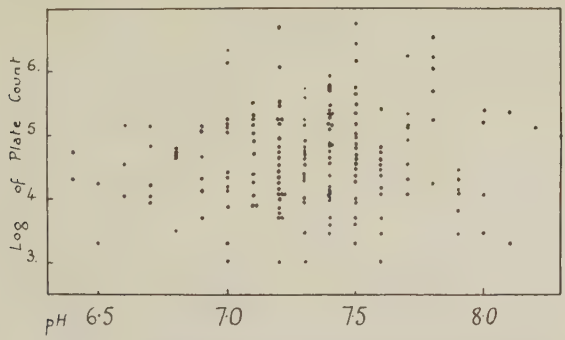

Fig. 2.—*Correlation diagram showing relationship between pH and bacterial counts.*

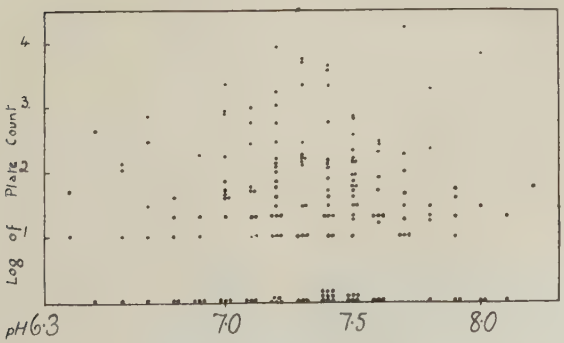

Fig. 3.—*Correlation diagram showing relationship between pH and yeast counts.*

TABLE 1.

pH's of choicest, amended and all butter samples, showing percentage distribution.

pH ..	6·4	6·5	6·6	6·7	6·8	6·9	7·0	7·1	7·2	7·3	7·4	7·5	7·6	7·7	7·8	7·9	8·0	8·1	8·2	8·3
Choicest Butters ..	0	0	1	2	0	2	3	4	9	5	11	12	5	5	3	3	3	0	0	1
% of Total			1·5	2·9		2·9	4·3	5·8	13·0	7·3	16·0	17·5	7·3	7·3	4·3	4·3	4·3			1·5
Amended Butters ..	2	2	3	3	5	4	10	9	16	12	16	11	7	4	3	3	1	2	1	0
% of Total	1·7	1·7	2·6	2·6	4·4	3·5	8·8	7·9	14·0	10·5	14·0	10·0	6·1	3·5	2·6	2·6	0·8	1·7	0·8	
All Butters	2	2	4	5	5	6	13	13	25	17	27	23	12	9	6	6	4	2	1	1
% of Total	1·1	1·1	2·2	2·7	2·7	3·3	7·1	7·1	13·6	9·3	14·7	12·6	6·6	4·9	3·3	3·3	2·2	1·1	0·6	0·6

incubated at 25° C. for 5 days. Owing to the fact that the investigation had to be planned to fit in with routine control work, the replication of results for the determination of the error of estimation was found to be impracticable.

In the scatter diagrams shown in Figures 2 and 3, each dot represents the pH of a sample plotted in pH units with the bacterial or yeast counts plotted as the logarithm of the actual count. In the case of the yeasts, a considerable number of the samples showed no colonies in the 1/10 dilution and are represented by dots placed as near as possible to the base line. The results show that within the limits of the technique employed in the routine examinations, no correlation between the pH and bacterial or yeast counts could be observed.

The results obtained in these examinations offer some indirect evidence on the problem of the neutralisation of cream for butter making. The deleterious effect of high acid on salted butter has been established by numerous workers, but an optimum degree of acidity in relation to good keeping quality is still a matter of speculation. Within the last 10 years the general practice of " neutralising " cream to 0·15 per cent. as lactic acid has given place to 0·05 to 0·1 per cent. as the popular end-point. However, the belief still exists in the industry that neutrality is the danger point in regard to butter quality. This belief is founded on the assumption

that the alkaline condition of the serum causes a breaking down of the butter-fat and also favours the rapid growth of putrefactive types of bacteria. Actually the above figures show that the true neutral point is exceeded in the majority of factories due to the difference between titratable and theoretical neutrality. In addition to the lack of correlation between the pH of the serum and the bacterial and yeast counts of the samples examined, there was no evidence to suggest that increased alkalinity favoured the development of proteolytic types.

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EFFECT OF CARBON BISULPHIDE ON THE BAKING QUALITY OF WHEAT.

In warm countries, the preservation of small samples of wheat which are to be tested for baking quality has always been a serious problem because of the ravages of insect pests, particularly the grain weevil (*Calandra* spp.).

For many years, all grain samples in this laboratory were fumigated with carbon bisulphide, the use of which was first reported in 1857. As a fumigant carbon bisulphide was quite effective, and it was thought to have no effect on baking quality, but its objectionable odour and inflammable nature rendered it unsuitable for frequent use in a laboratory. It was decided, therefore, to determine whether adequate control of insect pests could be obtained by means of some fumigant with a less objectionable odour and which at the same time was non-inflammable. The fumigant chosen was a mixture of 75 per cent. ethylene dichloride and 25 per cent. carbon tetrachloride.

Deleterious Effect of Carbon Bisulphide.

Early experiments with the above mixture, commenced in June 1936, showed it to be quite effective in destroying insect life, and it was found to have no effect on flour quality, but carbon bisulphide which was used as a control had a definitely weakening effect upon the flour.

Since making this discovery, this mixture has been used exclusively in this laboratory for all routine work, but further experiments were undertaken to obtain more definite information concerning the effect of carbon bisulphide on baking quality. The wheats chosen for the investigation were :

1. A mixture of several varieties of strong hard wheats grown in New South Wales, the main varieties being Pusa, Ideal, S.H.J., Carrabin and Gular.

2. Winnipeg Average No. 1 Northern (1936 crop).

Strong wheats were chosen because the response to variations in treatment are greater than in the case of weak wheats.

Three 2,000 gramme lots of *1* and *2* were placed in tins with close-fitting lids. One sample of each was left untreated; one was treated with 25 c.c. of ethylene dichloride-carbon tetrachloride mixture, and the other with 25 c.c. of carbon bisulphide. The fumigant was placed in small beakers filled with cotton wool. Two months after fumigation the samples were milled. The flours were baked and tested by the Farinograph within a week of milling and again after a period of two months, during which time they were kept in air-tight tins.

The development and stability times of the Farinograph curves are shown in Table I.

TABLE I.

Development and Stability Times of Farinograph Curves made with Flours Milled from Treated and Untreated Wheats.

(*a*) Immediately after milling.

Treatment.	New South Wales Hard.			Canadian I.		
	Development Time.*	Stability Time.†	Total Development and Stability.	Development Time.*	Stability Time.†	Total Development and Stability.
Untreated ..	9½	6½	16	11	8	19
Carbon bisulphide	5	2	7	6	8	14
Ethylene dichloride-carbon tetrachloride	8	7	15	13	6	19

(*b*) After two months' storage.

Untreated ..	11	4	15
Carbon bisulphide	9	1	10
Ethylene dichloride-carbon tetrachloride	10½	4	14½

* Development time is time taken for curve to reach maximum consistency.

† Stability time is time taken for curve to fall 10 units in consistency after attaining the maximum.

It is apparent from the Farinograph data that carbon bisulphide had a decided weakening effect, whereas the ethylene dichloride-carbon tetrachloride mixture had little or no effect on flour quality. Two months' storage resulted in an improvement in the carbon bisulphide treated flour, but it was still

considerably inferior to the untreated flour which had also improved slightly. The curves produced by the carbon bisulphide treated flours were typical of certain New South Wales wheats which characteristically have a relatively high percentage of gluten of moderate quality, and which are classed as medium strong. Typical examples would be Baringa, Gullen and Dundee. The gluten of these wheats is of the slack sticky type, as opposed to the tough elastic type characteristic of Canadian No. 1 Northern or of the New South Wales hard mixture.

The loaf volume measurements set out in Table 2 indicate that there is a close correlation between Farinograph and baking results. The carbon bisulphide treated flours gave small " green " loaves, by both malt-phosphate and malt-phosphate-bromate procedures when baked soon after milling, but after a period of two months there was a considerable improvement such as always occurs when immature flours are stored. The doughs made from the carbon bisulphide treated flours were of poor handling quality, and the texture of the bread was coarse and heavy.

TABLE 2.

Loaf Volumes of Treated and Untreated Flours Baked Immediately after Milling and after Two Months' Storage.

Flour.	Treatment.	Loaf Volume 1st Baking.		Loaf Volume 2nd Baking.	
		Malt-Phosphate.	Malt-Phosphate-Bromate.	Malt-Phosphate.	Malt-Phosphate-Bromate.
N.S.W. Hard ..	Untreated	590g	735	650Slg	730Slo
N.S.W. Hard ..	Carbon bisulphide	520vg	545g	575	615
N.S.W. Hard ..	Ethylene dichloride-carbon tetrachloride	610g	725	610Slg	720Slo
Canadian ..	Untreated	585g	605	650Slg	715
Canadian ..	Carbon bisulphide	545vg	540g	600g	620
Canadian ..	Ethylene dichloride-carbon tetrachloride	580g	580	630Slg	710

Slg means " slightly green."
g means " green."
vg means " very green."
Slo means " slightly old."
o means " old."

Changes in Flour Quality on Storage.

After two months' storage, all flours were improved but the characteristics of the loaves made from the carbon bisulphide treated flours gave no indication that the flour would be improved by longer storage.

In the prolonged storage of a flour two factors come into play :

(*a*) The maturation of the gluten of the flour, which is simply an increase in the degree of coagulation of the proteins.

(*b*) The increase in acidity due to changes in the fats and lipids.

The maturation of the gluten, which is due to a slow oxidation of the protein complex, probably a change from the -S-H to the -S-S- condition, results in an improvement in baking quality up to a point because of the increased degree of coagulation which must result, but the increase in acidity appears to cause a deterioration in quality. Although after two months' storage the gluten of the carbon bisulphide flours was still far from being at its optimum point of maturity, it was apparent that some form of deterioration had set in, probably as a result of the increase in acidity. This is supported by the peculiar shape of the Farinograph curves of the stored carbon bisulphide treated flours.

Treatment of an Old Flour with Carbon Bisulphide.

Further support for this theory was obtained by the treatment with carbon bisulphide of an old deteriorated flour. There was no improvement in loaf volume although the loaf was " green " instead of " old ". However, the flavour of the bread was still characteristic of an old loaf, which would indicate that the effect of the carbon bisulphide was to reverse the process of gluten maturation, the loaf having the appearance of being produced from a very acid flour with improperly matured gluten.

Purity of the Carbon Bisulphide.

In view of the fact that the carbon bisulphide used in the above tests was a commercial grade, it was possible that its effect on baking quality may have been due to impurities, but tests with the pure product gave exactly the same effect as that given by the commercial grade.

A possible oxidation product of carbon bisulphide is sulphur dioxide, the effect of which on flour quality was noted by Guthrie (cf. *N.S.W. Agricultural Gazette* 11 : 588, 1900 and 12 : 715, 1901). Tests carried out with sulphur dioxide and with sodium sulphite showed that minute quantities of these substances produced a similar effect to carbon bisulphide. It is reasonable to assume, therefore, that the deleterious effect of carbon bisulphide is due to small quantities of sulphur dioxide formed by oxidation. The results of tests on the effect of sulphur dioxide on flour quality will be discussed in detail in another paper.

L. S. Cayzer.

Department of Agriculture,
Sydney.

NITROGEN IN RELATION TO STUBBLE-SOWN CEREAL CROPS.

Field trials, at a score of country centres representing the agricultural areas of the lower north, central, and south-east districts of South Australia, and Yorke Peninsula, Eyre's Peninsula, and Kangaroo Island, were conducted jointly, in 1936 and 1937, by the South Australian Department of Agriculture and the Waite Institute. Trials on both barley and oats were included. The trials, with three exceptions, were sown on cereal stubbles. At two centres the trials were on ploughed-up grassland, and one trial was sown on a pea stubble.

The total rainfall in the year of the trial varied from 11·7 inches to 33·3 inches. The May-October rainfall varied from 6·8 inches to 24·0 inches. The average nitrate content of the soil to a depth of 18 inches ranged from 4 parts per million of dry soil to 21 p.p.m. The soil reaction varied from slightly acid, pH=6·6, to strongly alkaline, pH=9·1, as determined by the glass electrode method.

The yield of barley on the treatment receiving no sulphate of ammonia ranged from 1·6 bushels per acre to 63·2 bushels per acre, with the majority between 15 and 35 bushels per acre. The response to 1 cwt. per acre of sulphate of ammonia varied from a decrease of 1 bushel per acre to an increase of 15 bushels per acre. The response at eight out of sixteen centres was between 3 and 10 bushels, with a response of 11-12 bushels at three centres. The yield of oats on the no-nitrogen treatment varied from total crop failure to 37·8 bushels per acre, the majority of yields being above 10 bushels. The response to 1 cwt. of sulphate of ammonia varied from a decrease of 2 cwt. per acre of hay (grown on pea stubble under weedy conditions), and no increase, to an increase of 14 bushels per acre. In six only of twelve trials, the response exceeded 6 bushels per acre.

The results are being prepared for detailed publication in the Journal of the Department of Agriculture of South Australia. Although the trials at individual centres showed a marked difference in the response to sulphate of ammonia, the following general relationships were demonstrated :

(*a*) *With Rainfall.* Where waterlogging did not occur, the higher the rainfall during the growing period of the crop, the higher was the no-nitrogen yield and the larger was the response to sulphate of ammonia. May-October rainfall gave a satisfactory index of the rainfall during the growing period.

(*b*) *With Nitrate Content of the Soil at Seeding.* The no-nitrogen yields showed no correlation with the nitrate content of the soil at seeding ; but the higher the nitrate content of the soil at seeding, the less was the response to sulphate of ammonia.

(*c*) *With Soil Type.* Certain types of soil, including those of Yorke Peninsula, were characterized by a high nitrate content of the soil at seeding

and a poor response to sulphate of ammonia. Most of the soils studied were of alkaline reaction and the variation in degree of response appeared to be unrelated to soil reaction.

(*d*) *With Paddock History.* A study of the paddock histories of the areas of these trials showed that quite appreciable responses to sulphate of ammonia were obtained from rotations which included a period under fallow, and a period under pasture. Where the land had been heavily cropped with cereals over a number of years, weed competition in the stubble crop was serious and low yields and poor responses to sulphate of ammonia usually resulted. The history of the land, except in the season prior to the determination, does not appear to greatly influence the nitrate content of the soil. A period under fallow greatly increases the nitrate content and it is probable that a leguminous crop, ploughed under, or grazed, would also increase the nitrate content. A poor crop in a dry season may fail to use all the nitrate accumulated during a fallow the previous year, and this would leave the soil nitrate content at a level somewhat higher than normal.

D. C. Wark.

Waite Agricultural Research Institute,
South Australia.

POTASH DEFICIENCY AND ENZYME CONTENT.

Professor Doby, of the University of Budapest, has recently (Report of the Szechenyi Scientific Society, 1937) issued a report of his investigations on the enzyme content of rye and potatoes in relation to the soil status of potash and nitrogen.

The work was undertaken as a result of the observations of Doby and Hibbard (Michigan, U.S.A., 1924-25) that the leaves of sugar beet suffering from potash deficiency contained more than the normal content of invertase and amylase. After confirming these findings with *Penicillium glaucum*, the higher plants mentioned were made the subject of full investigation.

In both cases it was found that where soil-, and hence plant- potash, was low the two sucroclastic enzymes were present in high concentration. Phosphorus deficiency seemed to have no effect, but where nitrogen was deficient, the enzyme content was low.

Following the observation that there seemed to be some degree of proportionality between the deficiencies, respectively, of nitrogen and enzymes, it is now suggested that the results offer a prospect of getting information on the nitrogen status of a soil by a short laboratory method analogous to the Mitscherlich and Neubauer tests for potassium and phosphoric acid. This is being tested with soils of known and varying nitrogen contents.

From the Australian viewpoint, however, the work seems of interest in that it offers some explanation of the effect of potash upon the commercial sugar content of sugar-cane. It has been observed by the Bureau of Sugar Experiment Stations, Queensland, that where potash is omitted from a fertiliser treatment, especially if nitrogen is included, the c.c.s. is reduced. It is suggested that this, too, may be the effect of a high enzyme content converting the sucrose into glucose, fructose, etc. Whilst this lacks analytical confirmation, it seems feasible as might also the suggestion that the same cause might produce the well-known effect of potash in promoting a higher starch content in potatoes. Actually, in the latter case as in the former, the steps would be (*a*) potash deficiency, (*b*) consequent high enzyme content, and (*c*) the consequent breaking down of sugar and starch respectively under the influence of the invertase and the amylase.

G. DE V. DAVIS.

The Australian Institute of Agricultural Science

MEMORANDUM AND ARTICLES OF ASSOCIATION

Result of the Ballot.

Since the last issue of this Journal, the ballot on the acceptance of the Memorandum and Articles of Association of the Institute has been conducted. On 22nd March, voting papers were issued under cover of a memorandum from the President and with a printed copy of the official documents. The ballot closed, after the specified period of 60 days, on 20th May.

The following is the result of the count on the votes returned :

Number of Members Eligible to Vote.	Votes Recorded.	Per Cent. Poll.	In Favour.	Against.
355	237	67	236	1

Reference to Article 70 will show that an absolute majority is required in the result of such a ballot, and it is now possible to say that this has certainly been obtained. The Council is very grateful for the high percentage of votes recorded.

It is felt that the publication of this information in the Journal will be sufficient announcement of the result of the ballot, and that a special general meeting is unnecessary for the purpose. The Institute is therefore now operating under the new constitution, and it is hoped to hold the first Council meeting on 29th June. The Honorary Secretary is in communication with Branch Secretaries in regard to machinery matters.

THE JOURNAL.

Extracts from Report covering Publication of Volume 3, 1937.

Mr. E. T. Edwards resigned from the business management of the Journal on July 19, 1937.

Printing and Distribution. During 1937, 600 copies of each of the four numbers of Volume 3 were printed. Of these, 370 copies of each number were forwarded to members ; 40 copies to secretaries of State branches of the Institute ; and 96 to either subscribers, abstracting journals or institutions offering publications in exchange—making a total of 506 copies of each issue distributed.

Subscribers. A total of sixteen individuals or nine institutions subscribed to the Journal in 1937, an increase of four during the year. Of these, eight were resident in Australia, four in New Zealand, two in England, one in the United States, and one in China.

Repurchase of Back Numbers. As only 500 copies each of Volumes 1 and 2 were printed, and supplies of these numbers on hand were so limited, the Executive Committee in 1937

approved of the repurchase of Journals from members who did not with to retain them permanently. The total repurchased or returned, and the numbers now in stock are as follow :

	Number Repurchased or Returned.	*Total Number in Stock.*
Vol. 1—		
No. 1	17	36
No. 2	13	23
No. 3	12	54
No. 4	20	51
Vol. 2—		
No. 1	16	37
No. 2	18	37
No. 3	21	45
No. 4	17	33

Reprints. Reprints of sixteen articles from Volume 3, amounting to 3,100 copies, were purchased by authors or institutions employing them. This was a considerable decrease as compared with 1936, when reprints of twenty-five articles, and a total of 4,150 copies of papers were reprinted.

Binding of Journals. The Executive Committee approved of the binding of copies of Volume 3 for each of the State branches, and the Federal Secretary and Treasurer. Copies complete with advertisements were also bound for the Editor and Business Manager.

Cost of Publication. Accounts covering the cost of publication of Volume 3 have recently been completed and audited. Delay in completion of these accounts is always occasioned by the failure of members promptly to meet their accounts for reprints.

The actual cost of publication of Volume 3, after deducting receipts for reprints and subscriptions, amounted to £107 3s. 3d.

Housing of Institute Property. In 1937, a large six-shelf cupboard was purchased at a cost of £6 10s. This is now located in the room of the Business Manager, and should provide adequate storage space for stocks of back numbers of the Journal as well as the books, etc., of the Institute for some years.

N. S. Noble,
Business Manager.

MEETINGS OF BRANCHES.

CANBERRA BRANCH, F.C.T.

At a meeting of the Branch on December 6, members were addressed by Dr. G. A. Currie on " Places and Personalities " seen during his trip abroad. The speaker dealt first with southern France, where he was visiting a weeds research field station, then with Algiers and Paris. In England, he visited Farnham House Laboratory where weeds work is in progress, then attended the International Grassland Congress at Aberystwyth, Wales. In the United States, he visited Washington and discussed various phases of weed control, and was impressed—as every scientific visitor to America is impressed—by the extraordinary generosity and helpfulness of American scientists to visitors. Travelling by car through the southern States of America in company with Mr. Hitchcock of the Australian Prickly Pear Board staff, he saw the work of Range Research Stations in Texas, New Mexico, Arizona and in California, and in the last-named State saw the work being carried out by Dr. Crafts at Davis on chemical control of weeds. Dr. Currie stated that

the use of chemicals for weed control was increasing in most parts of the world—even in unexpected places, such as Hawaii, and in England in special crops.

The annual meeting of the Branch was held on the evening of March 24 in the Civic Hotel. After a dinner in the Hotel, members collected in the lounge and enjoyed an address by the President (Dr. B. T. Dickson) on the progress of the Institute. After the address the meaning of " status " was discussed at length and all members gave their opinions on this subject.

NEW SOUTH WALES BRANCH.

The seventeenth ordinary general meeting was held at Science House on April 29. There was an attendance of 48, including visitors. A letter received from Dr. J. G. Churchward tendering his resignation as President, was read by the Secretary. Principal E. A. Southee was then unanimously elected President for 1938. The financial statement showed a credit balance of £30 2s. 11d. The main business of the evening was a lantern lecture by Mr. J. N. Whittet, Government Agrostologist, on " Pasture Production in Overseas Countries ", an account of which appears under " Current Notes and News " in this issue. Representatives of banking institutions, fertiliser and seed firms, grazing and dairying interests, and machinery firms were amongst those who attended the meeting.

VICTORIAN BRANCH.

The third annual meeting of the Victorian Branch of the Institute was held on May 13, when the annual report and financial statement were received and adopted. Election of office-bearers resulted as follows: *President*, Mr. J. Brake; *Vice-President*, Mr. W. B. Miller; *Hon. Treasurer*, Mr. C. E. Cole; *Hon. Secretary*, Mr. A. T. Pugsley; *Members of Committee*, Messrs. F. M. Read and A. W. Jessep; *ex officio*, Professor S. M. Wadham; *Hon. Sub-Editor*, Mr. F. S. Crawford; *Hon. Auditor*, Mr. O. H. Gepp.

At December 31, there were 75 corporate and 13 student members on the rolls of the Victorian Branch. There were no resignations during the year. Eight meetings were held in conjunction with the Melbourne University Agricultural Society, reports of which have appeared from time to time in this Journal.

The sub-committee, consisting of Messrs. J. A. Aird, A. B. Hackwell, P. S. Lang, G. W. Leeper and A. J. Vasey presented a report setting out the progress made with regard to a study of agricultural potentialities in Victoria. This will be the subject of further discussion in the coming year.

SOUTH AUSTRALIAN BRANCH.

The annual general meeting of the South Australian Branch was held on Thursday, March 24. The Secretary's report and Treasurer's financial statement for the preceding year were each adopted.

The following office-bearers were elected for 1938: *President*, Mr. W. J. Spafford; *Vice-President*, Dr. A. R. Callaghan; *Hon. Sub-Editor*, Dr. H. C. Trumble; *Hon. Secretary*, Mr. C. M. Donald; *Hon. Treasurer*, Mr. C. S. Piper; *Committee Members*, Professor J. A. Prescott, Mr. A. G. Strickland and Mr. J. K. Taylor.

It was decided that the Director of the Waite Institute be approached for permission to use the lecture room of the Institute for its general meetings. This permission was subsequently given.

Mr. J. W. Wainwright, B.A., Auditor-General in South Australia, delivered an address entitled " Factors Affecting Secondary Production in South Australia ". Mr. Wainwright, who possesses an intimate knowledge of the secondary industries in South Australia, outlined recent trends in the relative distribution of breadwinners among primary, secondary

and tertiary industries, and showed that the latter class of employment had made material gains at the expense of the primary class, while the numbers engaged in secondary industry had maintained a slight but steady increase. In discussing the reasons for these changes, which are still proceeding in the same direction, Mr. Wainwright referred in particular to private arrangements among manufacturers and the existence of price-fixing systems behind the shelter of tariff walls. An intimate glimpse of the manifold and complex effects of price-fixation, the buyers' bias, individual requirements of the retail purchaser, transport costs and various other factors on secondary production in South Australia, was given.

QUEENSLAND BRANCH.

The annual meeting of the Queensland Branch was held on Friday, March 29, when the following officers were elected for the current year: *President*, Professor E. J. Goddard, *Vice-Presidents*, Messrs. W. G. Wells and A. F. Bell; *Council Members*, Messrs. F. A. Perkins, P. J. Skerman and J. A. Weddell. The retiring President, Mr. W. G. Wells, dealt with " Soil Conservation in the United States of America ", basing his address on a recent trip to that country. Excellent lantern slides were used to illustrate the talk, and the argument led logically to the discussion of the part that American practice can play in the comparable Queensland problem.

WESTERN AUSTRALIAN BRANCH.

The deferred annual meeting was held on April 1, when the retiring Branch President (Mr. H. A. Pittman) delivered an address on " Some Economic Considerations arising from a Study of Plant Pathology ". Officers elected for the ensuing year were: *President*, Dr. L. J. H. Teakle; *Vice-President*, Professor J. E. Nichols; *Secretary-Treasurer*, Mr. R. P. Roberts; *Committee*, Messrs. Baron-Hay, Conochie (students' representative), Pittman, Shier, W. Southern and Thomas.

With the completion of the accommodation for The Institution of Engineers in the new Gledden Building, the Institute now has permanent quarters which it shares with other professional bodies of the State. It is hoped that this move will foster the professional spirit among our members.

The commencement on April 21, 1938, of the construction work on the new agricultural science buildings at the University, Crawley, marks a very important milestone in the progress of agriculture in Western Australia. With the £14,000 available for buildings and equipment, the first unit of the agricultural block will be constructed for teaching and research purposes. Accommodation will be available for visiting research workers both from within and without the State.

TASMANIAN BRANCH.

The third annual general meeting was held at Hobart on April 22, with a full attendance of members.

The recently adopted constitution was considered and at the conclusion of the general business the retiring President (Mr. J. O. Henrick) gave a short address. Mr. Henrick stated at the commencement that he intended to depart from the usual procedure on such occasions, and to deal briefly with the aims and objects of the A.I.A.S. and the furtherance of these in the Tasmanian Branch. Many helpful suggestions were offered and a progressive policy outlined which, with the cooperation of all members, it is hoped may be effected.

The following officers were elected for the ensuing year: *President*, Mr. J. W. Evans; *Vice-President*, Mr. J. O. Henrick; *Hon. Secretary and Treasurer*, Mr. D. Martin; *Committee*, Mr. J. T. Armstrong and Mr. R. A. Sherwin; *Sub-Editor*, Mr. T. D. Raphael; *Auditor*, Mr. R. H. Dickenson; *Delegate to Federal Council*, Mr. J. W. Evans.

Current Notes and News

Dr. John Hammond—Address in Sydney.

A joint meeting of the Australian Veterinary Association and the Australian Institute of Agricultural Science (N.S.W. Branches) was convened on April 11 to hear an address by Dr. John Hammond, the well-known English authority on animal breeding and nutrition. The excellent attendance and the stimulating nature of the discussion which followed the address were evidence of the great interest which veterinarians and agricultural scientists alike have in the subject matter of the address, and of the high esteem in which Dr. Hammond is held.

The address was divided into two sections: first, "Principles of Breeding", and secondly, "Sterility". In discussing principles of animal breeding, Dr. Hammond drew a distinction between animal and plant breeding. It was pointed out that an animal breeder brings about an improvement in his stock by directing the evolution of his animals along certain lines, whereas a plant breeder relies for his successes mainly upon the combination of existing characters by cross breeding. Dr. Hammond believes that normal evolution is a gradual and continuous process, which is due to the development of new genes, in response to the environment, and not to changes in old ones. He considers mutations are of little value to the animal breeder as they are retrograde steps. It was also pointed out that new genes are dominant, whereas mutations are generally recessive. To illustrate his theory, Dr. Hammond took as examples the evolutionary development of the horse in response to its environment, and the remarkable improvement brought about by breeders in various domestic animals by merely directing the evolutionary development of the species upon certain lines.

It was emphasised that breed differences are only fixed in relation to the environment, and stress was laid upon the great importance of nutrition in animal breeding. It was pointed out that only when the ainmals are on a high plane of nutrition is it possible for the breeder to achieve success.

In discussing the question of sterility Dr. Hammond again emphasised the importance of nutrition. He pointed out that a high level of nutrition of the animal is accompanied by high fertility, and *vice versa*.

In answer to a question concerning the gradual deterioration, or deviation from type, of many English breeds of live stock in Australia, notably Jerseys, Clydesdales and Herefords, Dr. Hammond stated that it was all a question of nutrition, and that if it were desired the "type" could be maintained by keeping the animals on a plane of nutrition similar to that upon which the breed had been developed.

Pasture Production in Overseas Countries.

In his address to the N.S.W. Branch of the Institute on April 29, Mr. J. N. Whittet stated that the importance placed in England and Wales on the conservation of the surplus growth of permanent pastures as grass hay for winter feeding was exemplified in the 1937 statistics, which show that 4,671,000 acres were harvested for this purpose; in addition 1,469,000 acres of clover and rotation grasses were also cut for hay. Perennial rye grass and white clover are the dominant species in the better class pastures; lime and phosphate content is maintained at a high level by regular applications of these ingredients, using the equivalent of one ton of ground carbonate of lime per acre every five years, and six hundredweight basic slag per acre once every three years. In the United Kingdom, red clover is universally used for hay, soil fertility building and grazing purposes, and should be more extensively utilised for similar purposes on the arable lands of the higher rainfall zones of

Australia. Some of the most valuable research on pastures is being conducted at Cockle Park Experiment Station, Northumberland, and the Plant Breeding Station, Aberystwyth, Wales. The " Cockle Park Seed Mixture " is a household quotation amongst grassland farmers in Great Britain.

In Sweden, the area of cultivated fields is no less than 71·1 per cent. of the total area of the southernmost part of the country, and agricultural practices are on a very high standard. Grass, clover, cereal and root crop seed improvement work is at a very high level, and practically all seed sold is bagged, sealed and certified. State sealing of seed was instituted in this country fifty years ago. In the well farmed localities, it is considered that one-third of the farm should be under red clover ; this plant is looked upon as their soil nitrogen builder in the rotation programme, and hay and silage is made principally from this species and timothy.

The pasture research and experiment work of Denmark is similar to that carried out in Sweden. As is the case with Sweden, the seed testing station aids the grower in supplying seed of good quality to the purchaser. In many cases the grower and the seed merchant contract that the seed delivered should be paid for according to its purity and germination. No Seeds Act operates in Denmark, but twenty-five firms, who handle about two-thirds of all the seed sold in that country, have signed agreements with the seed testing station to deliver purity and germination guarantees with all clover grass or root crop seed sold ; the genuineness of variety and strain is tested in the control fields of the station.

As is the case with other European countries, the best areas of Germany are devoted to arable farming, and here again temporary pastures of perennial rye, timothy and red clover occupy a prominent place in the rotation ; permanent grasslands are mainly located on moorlands and country too steep for crop production. At the Experiment Grassland Farm, research on pastures shows that (*a*) the removal of lime, phosphate and potash from the soil is greatest when grass is cut young and often, (*b*) the percentages of nitrogen, lime, phosphate and potash in pasturage decrease in the pasturage as maturity increases, (*c*) the lime content of legumes is increased where potash is applied to pastures.

In the United States of America, Mr. Whittet's itinerary was planned mainly to cover the grassland work of the Department of Agriculture in the low rainfall zones of Nebraska, Kansas, Colorado, New Mexico and Arizona because he was of the opinion (*a*) that the results obtained in these areas were likely to throw some light on problems associated with the management of our semi-arid pasture zones, (*b*) that species of drought-resistant pasture plants were growing there, which would be worth collecting for trial in Australia.

Melbourne University Agricultural Society.

On April 8, Dr. John Hammond, Physiologist at the Animal Nutrition Institute, Cambridge, addressed a combined meeting of the Melbourne University Agricultural Society and the Victorian Branch of the Australian Veterinary Association. After expounding his rather unorthodox views on certain genetical principles, the lecturer went on to state that Mendelism had explained the mechanism of inheritance but not the mechanism of evolution. Dr. Hammond considered that with due consideration to environmental influence, a breeder could change an animal purposefully without waiting for a chance mutation to turn up. The progeny test for bull indexing was one of the main applications of genetics to animal husbandry, continued Dr. Hammond. Factors in the control of fertility and methods for the diagnosis of pregnancy in cows and mares were discussed also.

The sixteenth annual meeting of the M.U.A.S. was held on April 29. The membership in 1937 reached a total of 140, 15 being life members. The financial position of the Society again is very satisfactory. During the year, nine meetings were held in conjunction with

the Victorian Branch of the Institute and amicable contact has been maintained throughout that time. The average attendance has been 60.

The following office-bearers were elected for 1938 : *President*, Mr. J. A. Aird ; *Vice-Presidents*, Messrs. L. C. Bartels and O. H. Gepp ; *Hon. Treasurer*, Mr. A. O'Brien ; *Hon. Secretaries*, Messrs. A. A. Lee and R. W. Spicer ; *Graduate Representative*, Mr. J. L. Provan ; *Undergraduate Representative*, Mr. P. T. Mitchell ; *ex officio*, Professor S. M. Wadham and Mr. J. L. Gillespie. The address for the evening was given by the retiring President, Mr. J. L. Gillespie, the title being " Some Notes on Agricultural Extension Work in Australia ". The substance of this address is published in the main section of this number.

Agricultural Sciences Club, S.A.

The tenth annual general meeting of the Club was held on Thursday, April 28, 1938, in the new lecture room of the Ranson Mortlock Laboratory, at the Waite Institute. A record attendance of thirty-five members and visitors were present. Office-bearers for the ensuing year were elected as follows : *President*, Dr. A. H. K. Petrie ; *Vice-President*, Mr. D. B. Adam ; *Secretary*, Mr. D. C. Swan ; *Members of Committee*, Professor J. A. Prescott, Dr. Allan Walkley and Mr. R. J. Best.

A welcome was extended by the retiring President, Mr. D. B. Adam, to Miss J. McNeil, who has been appointed to carry out investigations on citrus fruits, Mr. A. L. Pinches of the Woods and Forests Department, S.A., Dr. J. G. Wood, Professor of Botany in the University of Adelaide, Mr. A. G. Lowndes, Land Utilization Officer of the Bank of New South Wales, and Mr. A. M. Stewart, Lecturer in Agriculture in the University of Western Australia. The evening was then devoted to a discussion on " Plant Regeneration in Areas of Low Rainfall ", an account of which appears elsewhere in this issue.

Farrer Oration—Farrer Memorial Medal.

The third oration in memory of William James Farrer was given by Dr. W. L. Waterhouse on April 3 in a programme broadcast by the national network of radio stations. It was recalled by the speaker that the first oration was given by the Prime Minister, Mr. Lyons, and the second by Dr. G. L. Sutton, who was then Director of Agriculture in Western Australia. The third was given by Dr. Waterhouse as the first of the Farrer Research Scholars. After giving a brief biography of the great plant breeder and a description of the valuable results of his work, a tribute was paid to Farrer's pioneering spirit, which was an inspiration to present-day workers to continue with the work. The speaker emphasised that although Farrer had done much, very serious problems still face the wheat industry, and the overcoming of these problems and making further improvements is no easy task.

At the ceremony of conferring of degrees at Sydney University on May 14, Dr. Waterhouse was presented with the Farrer Memorial Medal, the presentation being made by Mr. G. W. Walker. Mr. Walker stated that it was largely due to the efforts of Mr. F. Gallagher, M.A., that funds had been made available so that a medal could be given to the person selected to deliver the Annual Farrer Oration.

Award of D.Sc.Agr. Degree.

The degree of Doctor of Science in Agriculture (Sydney) was conferred on Mr. Norman S. Noble last month, for a thesis entitled " Studies on Australian Phytophagous and Parasitic Chalcidoidea ". The investigations concerned a number of different species of gall-forming and parasitic Chalcid wasps, and included studies of several new species, each of which in its larval stages is both phytophagous and parasitic. This was the first occasion

on which the D.Sc.Agr. degree had been conferred by Sydney University for a thesis in entomology.

Dr. Norman Noble graduated B.Sc.Agr. with first class honours in 1928, and then joined the staff of the Entomology Branch in the N.S.W. Department of Agriculture. In June 1928 he was transferred to Bathurst Experiment Farm to investigate the life history and control of codling moth ; while there he also worked out the life history of the apple leaf jassid, and devised control measures for that pest. In June 1929 he was awarded the Walter and Eliza Hall Agricultural Research Fellowship, and proceeded to the Imperial College of Science, London, where after one year's advanced study and research he was awarded the D.I.C. The second year of the Fellowship was spent at the University of California, Berkeley, where he secured the M.Sc. degree. While abroad, special attention was devoted to the biological control of insects, and since returning to the Department he has been engaged in the importation and development of parasites of insect pests.

Dr. Noble is Assistant Entomologist in the State Department, Lecturer (part-time) in Entomology at the Sydney Technical College, Business Manager of the Journal of the A.I.A.S., President of the S.U. Agricultural Graduates' Association, and was the first Treasurer of the N.S.W. Branch of the A.I.A.S. He is the author of a number of papers embodying research on various groups of insects—particularly in reference to the morphology and biology of native and introduced parasitic wasps.

Goodwill Tour to South Africa—Dr. A. R. Callaghan, Leader.

Dr. A. R. Callaghan, Principal of Roseworthy Agricultural College, departed on May 21 for South Africa as the leader of a goodwill tour by a party representing Australian primary and secondary industries. The tour will last for about four months, and it is expected that the party will travel 5,000 miles while in South Africa. The visit is being sponsored by the South Australian Government, leading stock and station agents, and the Chambers of Commerce and Manufactures. The party will consist of about ten members, most of whom are farmers or graziers. While in Africa, the party will be under the sponsorship of the South African Government and the Wool Council.

Referring to this matter last month, the Premier of South Australia stated : " In appointing Dr. Callaghan to lead the goodwill tour of South Africa, the Government had in mind two factors, firstly, that a Government representative should in every way be fitted and qualified to lead such an important delegation, and, secondly, that the tour would give him an opportunity to gain first-hand knowledge of some of the problems of South African primary production. The Government felt sure that the information Dr. Callaghan gained would not only be of value to him personally, but also to the State as a whole. Dr. Callaghan not only possesses great academic qualifications, but is practical to the highest degree. This has been proved abundantly by his administration of Roseworthy College, where his work has been outstanding."

Opening of Ranson Mortlock Laboratory, Waite Institute.

The new Ranson Mortlock Laboratory for the investigation of problems of soil erosion and plant regeneration, was officially opened by His Excellency the Governor of South Australia (Sir Winston Dugan) on April 26, 1938. A large number of guests was present, and exhibits were shown in the various laboratories.

The building was the gift of Mrs. Rosye Mortlock and her son, Mr. John Tennant Mortlock, in memory of the late Mr. Ranson Mortlock, Mrs. Mortlock's younger son. The full amount of their benefaction was £25,000, of which not less than £10,000 was to be spent in the erection of a building, and the balance was to be held as an endowment fund for the prosecution of research into the difficult problem of soil erosion and plant regenera-

tion in the pastoral districts of South Australia, which had been laid waste by drought, over-stocking and the incursions of rabbits.

The foundation stone was laid by Mrs. Mortlock on May 2, 1937, and the building became ready for occupation early in 1938. Included among its features are a library, a lecture room and two major laboratories (41 × 24 feet in all four cases), laboratory accommodation for workers in agronomy, agrostology, bacteriology, spectrography and photography.

Meeting of A.N.Z.A.A.S. in Canberra.

The next meeting of the Australian and New Zealand Association for the Advancement of Science will be held in Canberra from January 11 to 18, 1939.

Programmes for sectional activities are well in hand, and for the information of members the following are the Secretaries of Sections of the Association for the Canberra meeting : *Agriculture*, Dr. J. R. A. McMillan ; *Botany*, Dr. C. Barnard ; *Chemistry*, Mr. G. Lennox ; *Zoology*, Mr. F. N. Ratcliffe. The local Hon. Secretary for the Canberra meeting is Dr. G. A. Currie.

Book Reviews

A TEXT BOOK OF PLANT VIRUS DISEASES, by Kenneth M. Smith, D.Sc., Ph.D.

(Pp. x+615, with 101 illustrations. First edition. London : J. and A. Churchill Ltd., 1937. Price, 21/-.)

Ancient as plant diseases undoubtedly are, existing knowledge of that extensive, intriguing and menacing group, the virus diseases, is of very recent origin.

Some five years ago, Dr. K. M. Smith gave us a general survey of the situation, emphasising particularly the methods then available for investigation in the group ; the present volume represents a courageous and highly successful attempt at characterisation of plant virus diseases which hitherto were recorded only in the voluminous and scattered literature on the subject.

The author discusses, at the outset, the difficulties involved in the choice of a suitable system of classification of the viruses themselves and eventually adopted a modification of a scheme suggested by Dr. James Johnson. The virus is designated first by the generic name of the host plant with which it is chiefly associated and subsequently by numerals, or in the case of strains of a particular virus, by numerals and letters. Under this scheme, for example, the potato leaf curl virus becomes *Solanum Virus 14* Appel and Quanjer and the bunchy top of banana virus becomes *Musa Virus 1* Magee. The arrangement of hosts is by families in accordance with Hutchinson's classification.

In so far as information is available, the virus designations are followed by lists of synonyms, records of physical and chemical reactions, modes of transmission, differential host reactions and finally by descriptions of symptoms on the host plant or plants concerned.

Ninety-five pages are devoted to a detailed account of insect and other vectors concerned in the transmission of virus diseases. This section includes diagnostic characters, life histories and observations on general ecological relationships.

A short section enumerates a number of suspected virus diseases requiring further investigation and finally a useful appendix provides means for preliminary determinations of virus diseases by reference to major symptoms associated with a particular host plant.

The book itself is well printed and illustrated.

The real value of a virus classification scheme obviously depends on the soundness of the individual characterisations, and serious difficulties in this connection have yet to be

overcome. This volume by Dr. Smith is welcomed not only for the wealth of information which it provides in a readily accessible form—it is the first work of its kind to do so—but of possibly even greater value is the impetus which it will provide for further investigation. There are many virus diseases now on record which require still further characterisation by the use of existing methods, unsatisfactory as the latter still are in some respects.

The volume under review will be of tremendous service to plant pathologists and to all who are interested in any way with the maintenance of health in plants, as well as to those concerned with problems relating to virus diseases generally.

R. J. Noble.

REPORT OF THE FOURTH INTERNATIONAL GRASSLAND CONGRESS, GREAT BRITAIN, 1937, Edited by R. O. Whyte, Ph.D.

(Pp. xxxiv+486, with 28 figures and 3 plates. Aberystwyth: Cambrian News, Ltd. Price, £2.)

This illuminating volume serves as a medium for the publication, in complete form, of the presidential address and the sixty-eight plenary and sectional papers delivered at the Fourth International Grassland Congress, held between July 8 and 23, 1937, under the presidency of Professor R. G. Stapledon.

The papers are in English or German according to the language in which they were delivered, but each is accompanied by a summary in both German and English. Short reports of the discussions following the individual papers are given in English, or in both German and English. Reports of a business meeting and the final meeting of the congress are included, and in addition there appears a full list of the delegates, with their addresses, an index of authors and an index of the contributors to the discussions.

Professor Stapledon's presidential address dealt with "greenness", as exemplified by grassland, and especially with the approach of the grassland investigator. Mapping and the classification of grasslands were regarded as primary necessities the world over. Of the main environmental groups—soil, climate and management—the latter was stressed as a master factor, providing "the key to the solution of the whole grassland problem". In particular, the concept of "rotation in time", by which management is varied according to the requirements of the pasture, as well as those of the animal, throughout the varying seasonal conditions of the year or years, was emphasised. It was shown that local seeds mixtures, based on station-bred strains, were capable of greatly improving grassland production at specific times of the year when normally there was a shortage. The address is characteristic of its author, and as usual, is stimulating.

In the short space at one's disposal, it is impossible to do justice to the wealth of material provided by the numerous plenary and sectional papers. It is perhaps sufficient to say that these provide an informative cross-section of recent grassland work practically throughout the world. The fact that the congress was attended by four hundred and fifty delegates from thirty-seven countries, and of whom about two hundred and fifty were British, will give some idea of the widely representative nature of the gathering.

Thirteen papers were presented at three plenary sessions prior to the division of the congress into six separate sections. The former were given by H. E. Woodman, V. Vezzani and E. Carbone, and by H. R. Marston on nutritional problems; by P. V. Cardon, N. Sylvén, T. J. Jenkin and by T. E. Miln on plant breeding and seed production; by H. Osvald and by E. Klapp on grassland management; and by E. Bruce Levy, L. E. Kirk, C. R. Enlow and by A. I. Virtanen on forest conversion, the valuation of pasture species, erosion control and associated growth respectively.

The fifty-five sectional papers are arranged under their appropriate sections, of which there were six, namely: (1) Grassland Ecology, including Range Management; (2) Seeds

Mixtures ; (3) Plant Breeding, Genetics and Seed Production ; (4) Manures and Fertilisers, Soil Aspects of Grassland ; (5) Nutritive Value of Pastures ; Fodder Conservation ; (6) Pastures, Management, Yields and Economics.

The report states that at a meeting of the Grassland Congress Association, Dr. D. S. Huizinga, of the Netherlands, repeated the invitation given at the Third Congress at Zürich to hold the Fifth Congress in the Netherlands in 1940. This invitation was accepted and Dr. Huizinga was elected President of the Fifth Congress. The congress was invited by Count Teleki, of Hungary, to hold its sixth meeting in that country in 1943.

The report does not of course record what to those who attended must have been the most valuable feature of the congress, namely the personal contacts and opportunities for informal discussion, both at Aberystwyth and on the various tours, which included the Cahn Hill Improvement Scheme, Northern England and Scotland. Nor does it record, except in so far as the consistent orderliness of the papers is in itself a tribute, the enormous amount of efficient organisation and untiring effort on the part of the joint secretaries, Mr. William Davies and Dr. R. O. Whyte, that must have been necessary to render so obviously successful both the itinerant and localised aspects of the gathering.

It forms, however, a very useful and compact reference to the majority of the more prominent grassland workers in the world, together with an indication of their fields, and their progress and viewpoints regarding their problems in those fields ; and as such it should be readily accessible to every worker whose activities are associated with the investigation of grassland.

H. C. Trumble.

RECENT ADVANCES IN ENTOMOLOGY, by A. D. Imms, M.A., D.Sc., F.R.S.

(Second Edition. Pp. x+431, with 94 figures. London : J. and A. Churchill Ltd., 1937. English price, 15/-.)

Recent additions to our knowledge of entomology, both in the fundamental, as well as the general economic field have been so extensive, and published results have assumed such proportions that it has proved increasingly difficult to keep in touch, even with the more important literature.

Consequently, the first edition of Dr. Imms' " Recent Advances in Entomology ", published in 1930, and summarising, as it did, in a clear and concise manner, outstanding developments in many aspects of the subject, met with an excellent reception.

Such has been the demand, and such the progress in the intervening years that the second edition has become necessary.

The original scope of the book has not been increased, but much of it has been rewritten in the light of present knowledge, and its volume has been increased by 56 pages.

Separate chapters deal with metamorphosis, palæontology and colouration. Two chapters each are devoted to a discussion of some aspects of morphology, and sense organs and reflex behaviour. Approximately one-quarter of the volume deals with various aspects of ecology, while the last quarter of the book is devoted to a discussion of parasitism and biological control.

As extensive publications on other important aspects of the subject, notably in connection with morphology and physiology, have recently appeared, Dr. Imms decided to omit any discussion of these. While appreciating the author's point of view, one feels that even if it had been necessary to increase its size, the inclusion in the present work of his broad reviews and competent summaries of these additional aspects of the subject would have been welcomed by all entomologists, and would have added considerably to the value of the book.

Of especial interest is the author's discussion of recent discoveries concerning the existence of hormones, which govern both ecdysis and metamorphosis in the Insecta.

Words are never wasted, and when one considers the breadth of the field under discussion, it is surprising how much detail which it has been possible for the author to include. The book is well illustrated, and carefully selected references are provided for the reader desirous of further information on any phase of the subject.

The specialist might be disappointed at the amount of space allotted to a discussion of his particular field. However, the author has designed this work especially for the teacher and the student, and while the book fulfils its purpose admirably, it will also be of great value to the specialist who desires accurate information regarding recent developments in aspects of entomology, with which he is not specifically concerned.

N. S. NOBLE.

THE PRESENT-DAY ROCK GARDEN, by Sampson Clay, M.A., Ph.D.

(Pp. xxvi+681, with 56 plates (12 full page) illustrating 100 plants photographically. London and Edinburgh: T. C. and E. C. Jack, Ltd., 1937. Price, 31/6.)

The book, written as a complementary volume to Farrer's standard work, "The English Rock Garden", furnishes information on plants whose suitability for the rock garden has been demonstrated during the past decade. The genera—except those of orchids, which, following Farrer, are treated separately—are arranged alphabetically, as also are the species within each genus. The location of species mentioned in the text, but not dealt with under their own heads, is facilitated by including at the end of each large genus an alphabetical list of these together with the names, in brackets, of the species under which they are to be found. Pages 675-681 consist of two appendices giving, respectively, the names of genera not placed alphabetically in the book, and those not mentioned otherwise. The photographic illustrations are all of excellent quality.

While it is not easy to assess the practical value to Australian rock gardeners of a book dealing with species chosen from the point of view of their ornamental value when grown under English climatic conditions, the range of species listed and described is very wide, and is representative of so many parts of the world that it includes an ample variety of forms suitable for our conditions. Moreover, the inclusion of Australian species of such genera as *Brachycome, Bulbine, Burchardia, Cæsia, Caladenia, Caleana, Calocephalus, Chamæscilla, Diuris, Drosera, Goodenia, Helichrysum, Podolepis, Thelymitra,* and many others, serves to show that our own native flora has not been overlooked as a source of rock garden plants.

To write descriptive notes, however brief, on some 700 genera and upwards of 14,000 species all within the compass of a book of less than 700 pages, and printed in easily legible type, is no mean achievement. To maintain throughout the book a literary style capable of claiming our attention at whichever point we choose to read is nothing short of remarkable. That this has, in fact, been done is proof of the author's familiarity with the plants he describes. Brevity has been achieved by the singling out of the most striking characters presented by each, and by the exercise of great care and skill in the choice of words and the construction of phrases to describe them. Thus, *Hænselera granatensis* is referred to as "a lovely crisp-leaved 6-inch Chicory of subalpine Spain", and *Helichrysum sessile* as "a flat carpet of half-inch silver rosettes, etc."

Not the least important part of the book is the 26-page introduction, which includes, amongst other things, a discussion of the species problem in the same easy flowing style as characterises the entire work. Dr. Clay does not hesitate to call a spade a spade, but there can be no doubt as to his knowledge of the entire contents of the implement shed. Particularly valuable is the emphasis placed upon the heterogeneous nature of the units to which the term "species" is applied by the *same* as well as by different botanists.

G. H. CLARKE.

Correspondence

PROFESSIONAL APPOINTMENTS

The Editor,
Journal of the Australian Institute
of Agricultural Science.

Dear Sir,

The objects for which the Australian Institute of Agricultural Science is established include the following :

> " To safeguard the best interests of the profession in all matters relating to appointments within the profession, to advocate the employment in technical positions of persons who are fully qualified, and to secure satisfactory conditions of employment."

Appointments within a profession are generally recognized as being the legitimate concern of all its members, and the profession of Agricultural Science is no exception in this regard. As the subject of my letter relates to this particular object of the Institute, your indulgence in the matter of its publication is requested.

University appointments are, by their nature, a focal point for the attention of graduates. They rightly may be considered as key positions, for they confer upon the recipient a position of authority and influence amongst the constant stream of undergraduates from which the ranks of the various professions are recruited. It is a matter for the concern of graduates, therefore, that positions of such responsibility should be adequately filled. This can only be done and the interests of professional bodies consequently be safeguarded if final selection takes place after consideration of all candidates who are qualified and likely to be interested.

There are certain cardinal democratic principles governing selection for positions of this kind which surely are just as applicable to a university as to any other public institution. A basis of equality of opportunity and impartiality of consideration so as to ensure that the best man available for the position has been chosen is obviously most desirable. Unfortunately, there have been definite indications in recent times that these principles of selection have not been observed in the case of certain appointments which are of intimate concern to Agricultural graduates.

I am deeply sensible of the weaknesses incumbent upon any departure from the principles outlined, and without stressing these considerations any further, it is to be hoped that the authorities concerned may deem it expedient to view this matter in the light in which it must appear to all who have the interests of their profession at heart.

I am, etc.,

SENIOR GRADUATE.

Sydney,
9th June, 1938.

Personal Notes

Canberra, F.C.T.

Dr. A. J. Nicholson, Chief of the Division of Economic Entomology, C.S.I.R., left Canberra on February 15th on a visit to America, Europe and South Africa. Dr. Nicholson is spending some time at Riverside, California, and then he proceeds through Canada to England, where he will make his headquarters at Cambridge. He will be official Australian delegate to the International Entomological Congress in Berlin. He will visit South Africa on his return trip, one of the principal subjects of interest there being red-legged earth mites, some species of which are so destructive in Western Australia. Dr. Nicholson who is accompanied on this trip by Mrs. Nicholson, will return to Australia towards the end of December.

Dr. C. Barnard, who is in charge of the Section of Horticulture, Division of Plant Industry, C.S.I.R., left Australia on May 12th to visit California and other American States to study fruit culture. He will travel to England, via Canada, and will visit research stations in both countries. He will then attend an International Horticultural Congress in Berlin and will be the official Australian delegate to that conference. Dr. Barnard will return to Australia via South Africa, where he will study all phases of horticulture, and will return to Canberra in December. During his tour his main interest will centre round apple and citrus cultural problems.

Mr. K. L. Hills of the Genetics Section of the Division of Plant Industry, C.S.I.R., has left Australia to study the breeding of pasture plants at Aberystwyth, Wales, under the direction of Professor Stapledon. He is travelling on a Senior Studentship from the C.S.I.R. for eighteen months. Mr. Hills is accompanied by his wife.

Mr. D. C. Norris has taken up a position in the Division of Plant Industry, C.S.I.R., at Canberra, to work on tobacco problems.

Dr. J. G. Bald of the Division of Plant Industry, in company with Mr. C. J. Perrett of the Department of Commerce, has been touring the potato-growing districts in each State in the course of surveying the problems which face the grower. The report will cover economic and cultural, as well as disease problems, and will be presented to the Standing Committee on Agriculture.

New South Wales.

Dr. W. L. Waterhouse has accepted the Presidency of the Agriculture and Forestry Section of the A.N.Z.A.A.S. Congress to be held in Canberra from January 11 to 18, 1939.

Mr. W. T. Atkinson, Walter and Eliza Hall Agriculture Research Fellow, left Sydney for New Zealand on April 7 on the first stage of a visit to overseas universities and plant breeding centres. He will spend the summer at the University of Saskatchewan, and will then spend seven months at the Universities of Minnesota and Wisconsin. Before returning to Australia in July, 1939, Mr. Atkinson will visit England and the Continent.

Mr. P. Hindmarsh has been appointed Principal of the Hurlstone High School, Glenfield.

Mr. G. de V. Davis recently paid a brief visit to New Guinea and the Mandated Territory.

Mr. A. W. S. Moodie has been appointed Senior Assistant Agrostologist in the State Department of Agriculture.

Dr. J. G. Churchward has resigned from the staff of Sydney University.

Appointments in the Faculty of Agriculture, Sydney University, recently announced are: Mr. I. A. Watson, Assistant Lecturer; Mr. D. B. Duncan, Lecturer in Agricultural Biometry; Mr. T. Kiely, Demonstrator. Each of the appointees graduated B.Sc.Agr. this year.

South Australia.

Farewell was tendered to Professor A. E. V. Richardson at a full gathering of the Waite Institute staff, including research, clerical and field workers, in the lecture room of the Ranson Mortlock Laboratory on February 23. Appreciative references to Professor Richardson's services to the Waite Institute were made by the Director, Professor J. A. Prescott, the Clerical Officer, Mr. G. L. Gooden and the Field Officer, Mr. K. A. Pike; and a presentation consisting of a cigarette box and case in silver to which every member had contributed, was made. Professor Richardson spent several weeks at the Waite Institute before leaving for Melbourne on April 5; he attended the official opening of the Ranson Mortlock Laboratory on April 26.

During his visit to South Australia, Dr. John Hammond met senior members of the staff at the Waite Institute on April 30 and spent some time at Roseworthy College on May 2. Dr. Hammond was conducted through the south-east of the State by Mr. R. C. Scott. He addressed a meeting in Adelaide on " Animal Husbandry and the Meat Export Trade " in the evening of May 2.

Messrs. R. I. Herriot, B.Agr.Sc. (Adel.), and R. Smith, B.Agr.Sc. (W.A.), have been appointed Assistant Research Officers in the Soils Division of the C.S.I.R.

Miss Jean McNeil, B.Sc. (Melb.), has been appointed to carry out investigations on citrus fruit preservation under the supervision of Mr. D. B. Adam. The investigations were made possible by a grant from the Citrus Preservation Committee of the C.S.I.R.

Victoria.

Professor A. E. V. Richardson has been granted the Commonwealth honour of C.M.G. This was granted by the King on the occasion of his birthday.

Permanent appointments to the professional staff of the Department of Agriculture include Messrs. H. L. Hore, Inspector of Agriculture; A. A. Lee, Assistant Inspector of Agriculture, and F. S. Crawford, Publications Officer.

Mr. O. H. Gepp has joined the staff of the Australian Paper Manufacturers Ltd. He was previously Advisory Officer to Nitrogen Fertilisers Pty. Ltd.

Queensland.

Research activities have recently been coordinated within the Department of Agriculture and Stock by the creation of a Division of Plant Industry (Research) with Mr. Robert Veitch as Director. Coincident appointments are Mr. W. G. Wells as Director of Cotton Culture and Senior Research Officer, and Messrs. R. E. Soutter, W. A. T. Summerville, J. H. Simmonds, H. K. Lewcock and J. H. Smith as Senior Research Officers in Agriculture, Horticulture, Plant Pathology, Plant Physiology and Entomology respectively. Mr. C. T. White, Government Botanist, is also attached to the Division.

Mr. W. G. Wells has resumed duty in Brisbane following a visit to the main cotton districts of the United States of America.

Mr. E. C. Tommerup has taken up duties with the Department as Soil Bacteriologist.

Western Australia.

Mr. L. C. Snook, as a temporary Research Associate at the Rowett Institute, Scotland, is making good progress in studies on pregnancy toxæmia of sheep.

Mr. C. Thiel is collaborating in the programme of work on the physiology of lactic acid bacteria at the Reading National Institute for Research in Dairying, England.

Dr. E. J. Underwood writes from Wisconsin to the effect that he is attending the American Chemical Society's meeting at Dallas, Texas, and will lead the minerals section with a general paper on " Minerals in Nutrition ".